Creative Mapping Landuse and Human Activities: From the Inventories of Factories to the History of the City and Citizens

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Abstract—Digital technologies offer possibilities to effectively convert historical archives into instruments of knowledge able to provide a guide for the interpretation of historical phenomena. Digital conversion and management of those documents allow the possibility to add other sources in a unique and coherent model that permits the intersection of different data able to open new interpretations and understandings. Urban history uses, among other sources, the inventories that register human activities in a specific space (e.g. cadastres, censuses, etc.). The geographic localisation of that information inside cartographic supports allows for the comprehension and visualisation of specific relationships between different historical realities registering both the urban space and the peoples living there. These links that merge the different nature of data and documentation through a new organisation of the information can suggest a new interpretation of other related events. In all these kinds of analysis, the use of GIS platforms today represents the most appropriate answer. The design of the related databases is the key to realise the ad-hoc instrument to facilitate the analysis and the intersection of data of different origins. Moreover, GIS has become the digital platform where it is possible to add other kinds of data visualisation. This research deals with the industrial development of Turin at the beginning of the 20th century. A census of factories realized just prior to WWI provides the opportunity to test the potentialities of GIS platforms for the analysis of urban landscape modifications during the first industrial development of the town. The inventory includes data about location, activities, and people. GIS is shaped in a creative way linking different sources and digital systems aiming to create a new type of platform conceived as an interface integrating different kinds of data visualisation. The data processing allows linking this information to an urban space, and also visualising the growth of the city at that time. The sources, related to the urban landscape development in that period, are of a different nature. The emerging necessity to build, enlarge, modify and join different buildings to boost the industrial activities, according to their fast development, is recorded by different official permissions delivered by the municipality and now stored in the Historical Archive of the Municipality of Turin. Those documents, which are reports and drawings, contain numerous data on the buildings themselves, including the block where the plot is located, the district, and the people involved such as the owner, the investor, and the engineer or architect designing the industrial building. All these collected data offer the possibility to firstly re-build the process of change of the urban landscape by using GIS and 3D modelling technologies thanks to the access to the drawings (2D plans, sections and elevations) that show the previous and the planned situation. Furthermore, they access information for different queries of the linked dataset that could be useful for different research and targets such as economics, biographical, architectural, or demographical. By

superimposing a layer of the present city, the past meets to the present-industrial heritage, and people meet urban history.

Keywords—Digital urban history, census, digitalisation, GIS, modelling, digital humanities.

I. INTRODUCTION

IN today's societies, census activities represents the best instrument to check and monitor human activities. The main aims of a census are usually to provide information to understand human needs inside a specific society and to plan future activities and actions able to reach a specific goal. At the same time, a census offers a clear description of a specific phenomenon inside a defined population in a specific time. For those reasons, a census conducted in the past could offer a basic source for historical studies and research to analyse, over a certain period of time or in a specific moment, the evidences of the monitored aspect of the life, and therefore, contribute to the understanding of an historical period. For these reasons, the census is a source generally and heavily relied on by social historians. Nevertheless, in many cases, the collected data could be more important for other historical studies than just the real direct motivations, which justified the census activity. A clear and well-known example of that is the cadastre. For centuries, government registered properties in order to certify private properties and land use to define the taxable incomes realized cadastral activities. Since the 18th-19th centuries, in most European countries, cadastres also were visualized in maps. The collected data, at the same time, offers a landscape of a portion of land (both urban and rural ones) and the land use which always is directly connected to economical aspect of life in the checked period. Cadastres include a map and other kind of data reported by the people executing the census, such as reports and notes. Nevertheless, the related information is not widely used, as it is quite difficult to access and to interpret by those who are not specialized. The ineffective use of these relevant sources also includes researchers. In a way, the census is underestimated by some historians, for example, those aimed at focusing on the urban physical space. At the same time, the relationships between data and the morphology and forms of the urban space – how the urban space is shaped and how its architecture represents the activities and ideals of citizens - are underestimated by historians focusing on social, economics, and demographic aspects of urban history.

Usually the data collected in the cadastre over a portion of

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land are georeferenced and represent an example of an old type of information system that today can be digitized and managed using GIS technology. More generally, for census data that are not related to maps and any georeferenced system, and so just contains systematic data without any kind of visualisation. That is the case of the census done at the beginning of the industrial development of Turin, when the municipality took the decision to register factories in the city.

In the following, a digitization of the census made at the beginning of the 20th century is described by putting in evidence, the criteria and the methodologies that our research used to translate an old document into a modern research tool.

It should be noted that according to the bibliography of the history of Turin, the census was not quoted until now by researchers as a reference or used in any way to acquire data. Therefore, this research offers a new source, as well as a new approach in using non-explicitly georeferenced data.

The new technologies applied to Urban History with Digital Humanities methodologies allows the use of digital technologies for the Humanities field with the goal of accessing new data and fostering new interpretation. In this regard, they have huge potential, but they also need to be shaped and addressed by the historical research to its targets. The digitization in this case has been done in the framework of a more complex research activity related to the urban landscape transformation evolution, therefore, some of the digitization strategies are influenced by the aims of the research.

The digitization of an archive is not merely a scanning of the contents, but a real database structuring activity that must be planned and shaped according to the specific goals of the research. The digitized data could also be used for other purposes, but in those cases, some modification of the logical links could be necessary. Therefore, the most important thing is to guarantee the correct recording of the single data digitization in a shareable format for the ease of future use.

II. THE CENSUS OF THE PRODUCTIVE ACTIVITIES IN TURIN

In 1914, the Municipality of Turin developed a census of all productive activities in its boundaries. The reasons for this action are not clear, but it is possible to imagine the aims of this activity. At the beginning of the 20th century, Turin was not yet an industrial city; however, it was at the beginning of the rebirth of FIAT, Italy's most prominent car manufacturer and its biggest company for many years following [2]. The census shows that at that time, the company was at the same level as others, as there were many more factories also involved in the production of cars.

From the last years of the 19th century, many artisan activities were located inside the town and especially in the areas around the old city that was closed by walls until the beginning of the 19th century. Factories sometimes used existing buildings, particularly if they were located in older districts. In many other cases, engineers and architects expressly designed new buildings, *ad-hoc* developing a new style for industrial buildings. The quantity of these new buildings is so important in the developing districts of the 20th

century city that suggests this style was shaping the new urban space and changing the urban image on a large scale. Furthermore, the change needed to include also the urban morphology that is the plan of the city designed since the 19th century in blocks corresponding to those of the old city for its enlargement. The rules of town-planning and building licenses were strongly influenced by the new prevalent function. The economic development of the manufacturing industry generated rapid growth of related activities by introducing new production strategies, which forced the union of small activities (mainly done by a few people) into greater production settlements. The numbers of workers increased, and therefore, also the necessities of new and larger spaces, as well as the need for energy. All those facts modify, or needed to modify, the building shape and organization, and as such, the municipality faced new urban planning problems. It is difficult to perceive this problem through a census, which is a sort of photograph of the state of affairs. With the aim to visualize and understand the process, the census needs to intersect more sources allowing for analysis and interpretation from a diachronic perspective. This approach also requires the use of the same historical perspective in designing the GIS of the census, changing it in an interface allowing for access to more data than the census itself [3], [4]. That way, the GIS of the census becomes a digital platform accessing the general dataset of the census and related information of factories and urban regions. The visualization takes into account the diachronic process by representing the change by modelling factories in their context. At the same time, the concentration of the new production activities demands the availability of a sizeable workforce residing in the area. Turin began to grow due the wave of people arriving in the city looking for work, and many of them came to reside near the factories, as public transportation was not developed at that time. Therefore, the process also involves a larger urban area and suggests an effect on surrounding residential areas determining the building make up of industrial districts.

The census of production activities in Turin represents the first survey of the status of production buildings in the city. The survey shows traditional production activities (e.g. tailors, and weaving mills) located within the ancient district of the city that has endured as the production centre of the walled city. Data also identified new industrial settlements on the southeast side during the 19th century enlargement of the district of San Salvario, and on the west side, especially beyond the Dora River. It represents a very important action taken by the municipality to survey its new regions.

It should be noted that this survey does not register any information about the condition of the lives of people. By considering the use of surveys in industrial cities, especially those developed in England since the 19th century (as is the case of the survey of London by Charles Booth on *The Life and Labour of the People of London* realised in 1891-1903 and published in 1902-1903), the survey of Turin registered limited data and contains poor information linkable to the people and their lives in the districts at the time. Nevertheless, the survey was recommended by the literature on town

planning (e.g. the text on *The Civic Survey of the Edinburgh* by Patrick Geddes. reprinted in 1911 after being presented at the Town Planning Conference). However, we do not know if the municipality intended to use it to monitor city growth or to plan for future development or develop urban policies, or if it was instead related with other needs, such as the imminent war. In a way, it represented a strategic area of the city when enemies attacked it. If Booth's survey of London was visualised through a "poverty map", and Geddes also accompanied his survey by drawings such as eye bird views and sketches of the city regions, the factories' survey of Turin was otherwise just a written description of the modernisation without any map of the sites and/or the urban area. In any case, the Turin survey is an unusual pioneering document surveying industrial growth, and is also interesting for different purposes. It should be noted that it was created by the official outlook of the municipality. By considering the data collected by the census and by joining other information from various archives (mostly the designs of new buildings to obtain building permission by local authorities, and other kinds of data such as cartographies, photographs, or descriptions of districts in tourist guides), this research uses the census for studying the development of the urban landscape. The outcomes also show how it can be used for understanding the history of human production activities for specific industrial sectors [5].

III. THE DIGITIZATION OF THE PRODUCTIVE ACTIVITY CENSUS

A. The Collected Data

The results of the census are collected in some hand written books preserved in the historical archives of the municipality of Turin (see Fig. 1). They identify different regions in the city as sectors of the survey.

The data collection was performed by using a standardized approach. The collected data are:

- name of the owner of the activity (single person or firm);
- location of the (address recorded with the name of the street and house number);
- kind of activity;
- presence of mechanical engines;
- number of workers (considering gender and age);
- sanitary conditions.

By taking into consideration the aims of the research, the most important information is the location and the kind of activity. The other data are not strictly connected to the main goals of the historical research, but they were also digitized and inserted into the database to allow for future use in different investigations.

Fig. 1 The collected data

B. The Cartographic Base

The selection of the geographic base takes into account the fact that the names of streets have changed over the years. Especially in Italy, during the Fascist period many street names were changed for political reasons, and again after WWII they were changed for the same (but with the opposite aim) motivation. Therefore, in the considered case, a map showing the street names at the same era is needed to avoid misunderstandings. Other important information that must be recovered is the location of house numbers, as it is well known this is not usual information on standard cartographic products. The chosen geographic base is a map printed to show the customs border of the town established in 1912: in this map, printed at a scale of 1:15,000, house numbers (with the density allowed by the adopted scale) are also printed (see Fig. 2).

The map was not produced by an official cartographic institution of Italy, and therefore some information about the reference and coordinate systems are missing.

By considering the history of some main buildings in the town, it is possible to find some points that are still present, which can allow for the referencing of the map against the most up-to-date technical map of Turin, which has a nominal scale of 1:1,000 and distributed by the municipality as a shapefile layer (see Fig. 3). This opportunity is essential for the historical research that wants to reconstruct the landscape evolution of specific parts of the town.
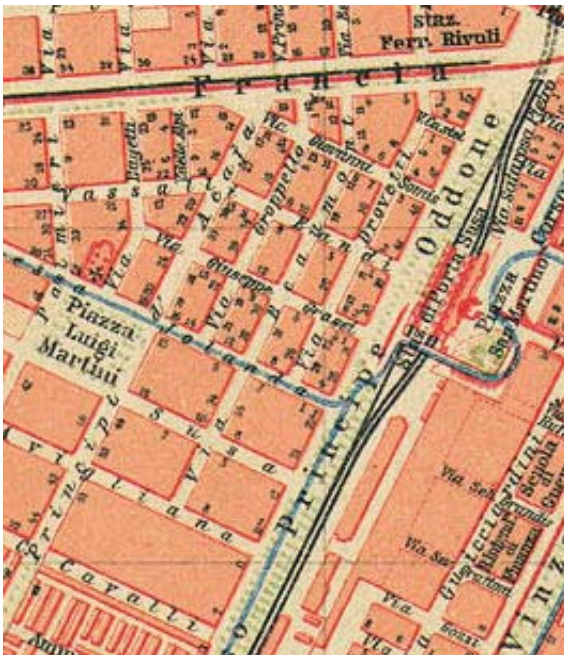

Fig. 3 Historical map referenced to today's map

Fig. 2 A detail of the used map

C. GIS Design

The collected data and the level of detail of the chosen cartographic base suggest the adoption of a feature point to locate the results of the census. Each point will represent a single activity and registered on the historical map manually.

For each of the features, a set of traits will be characterized using the following attributes:

SECTION: is the integer number (ranging from one to 25) which distinguishes the section of town where the activity is located (the whole town was subdivided into 25 different sections for different purposes and this subdivision was used to manage the census activities in a parallel approach);

SURNAME: is the surname of the owner of the activity recorded into a string;

NAME: is the name of the owner of the activity. If this field contains the string "DITTA", it means that the activity is owned by a firm;

STREET: is the name of the street as written in the registers using the same abbreviations and conventions adopted on the historical map;

HOUSENR: is the house number where the activity is located;

ACTIVITY: is the kind of activity as reported in the registers. This attribute is not very useful because the surveyors used a very large glossary and sometimes they wrote the same activity in different ways;

MACRO_ACT: is an attribute, which groups the very extensive set of activities classified during the census into more general families to speed up and generalize the queries useful to the research. In particular, single activities are grouped by considering the main purpose such as energy production and distribution, car manufacturing, or textiles;

MECH_ENG: is the number of the mechanical engines present and used for the activity;

HYG_COND: is the judgement of the surveyors about the hygienic conditions of work places. In this case, a Boolean variable has been used;

WORKERS: it is a set of four attributes which define the number of workers by subdividing them into male and female and adults and minors.
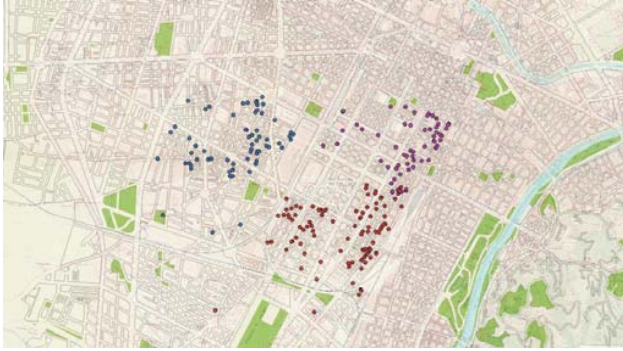
Fig. 4 Activities showed with different colours by considering the SECTION attribute

All the activities are stored in a unique layer to allow the distribution of the digitized data to other users by using the open shapefile format. The following figures show some simple queries about a section of the town.
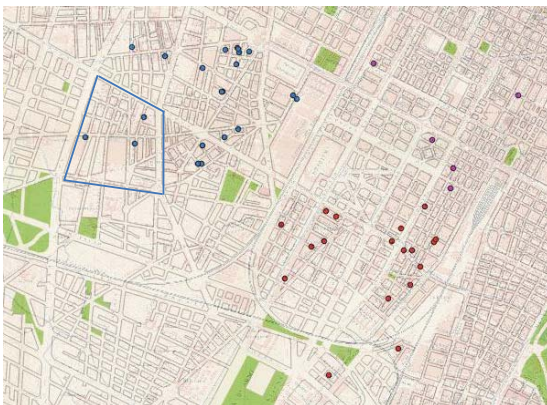

Fig. 5 Activities with more than 50 workers

Fig. 6 Activities related to car production (The Lancia's expansion area)

The basic queries that the database of the census allows is helping to understand, among the more than 1,800 activities, which are the ones related to car production in a specific area of the town. The search query shown in Fig. 6 refers to the history of one of the most famous Italian car firms, LANCIA, which will be used in the following paragraph as an example. Fig. 5 shows the activities connected to car production, which involves more than 50 workers.

IV. THE DEVELOPMENT OF THE LANCIA INDUSTRY IN THE BORGO SAN PAOLO QUARTER

A. Urban Landscape Analysis

By concentrating the analysis on the area shown in Fig. 6, a complete set of different maps have been collected in different archives of the town and georeferenced on the cartographic base of the GIS project. Using the information gathered from the drawings used by the owners of Lancia to obtain permission to build a new production centre, the 3D modelling of this part of the town has been realized to show the ways in which the urban landscape has changed from the beginning of the 20th century until the end of WWII [6], [7].

In the following figures, the historical steps of the growth of the buildings related to Lancia's production and the surroundings are presented.
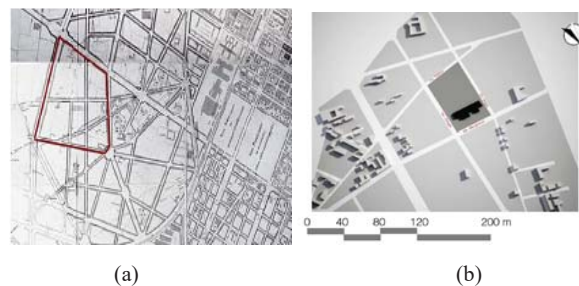

(a)   (b)

Fig. 7 Historical map 1908 (a) and 3D rendering of the urban landscape (b)

(a)   (b)

Fig. 8 Historical map 1915 (a) and 3D rendering of the urban landscape (b)

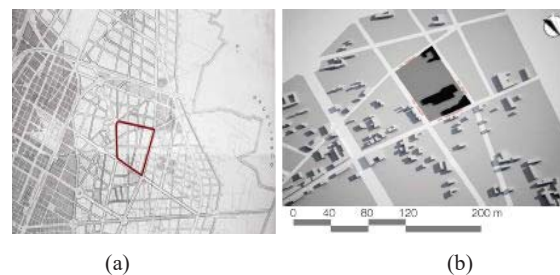(a)   (b)

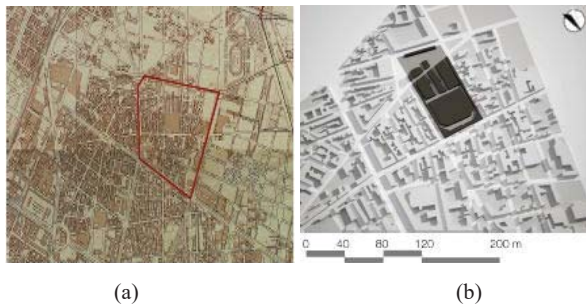Fig. 9 Historical map 1926 (a) and 3D rendering of the urban landscape (b)

Fig. 10 Historical map 1935 (a) and 3D rendering of the urban landscape (b)
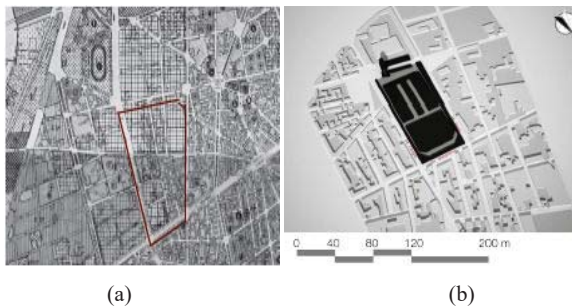

Fig. 11 Historical map 1959 (a) and 3D rendering of the urban landscape (b)

The different maps used have been georeferenced to the actual map of Turin using tie points located on buildings and cartographic details presented in the different periods, while the heights of the buildings are extracted from other sources (drawings and historical surveys).

By combining data from different sources in a homogeneous platform, such as the one provided by GIS technology, it is possible to collect and offer in a structured form of all the information needed to understand and visualize the urban landscape changes during a specific historical period.
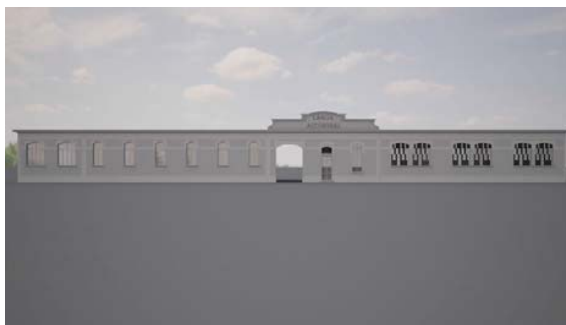
B. Architectural 3D Modelling

Fig. 12 The main façade in 1911

The buildings, as shown by the maps, do not exist anymore but the drawings used to obtain the construction permissions are preserved in the archives of the Municipality of Turin and allow for the enlargement of the scale of the historical

reconstruction of this part of the city. By using this information, it is possible to model the buildings as they were during the different phases of the growth of industrial settlements.
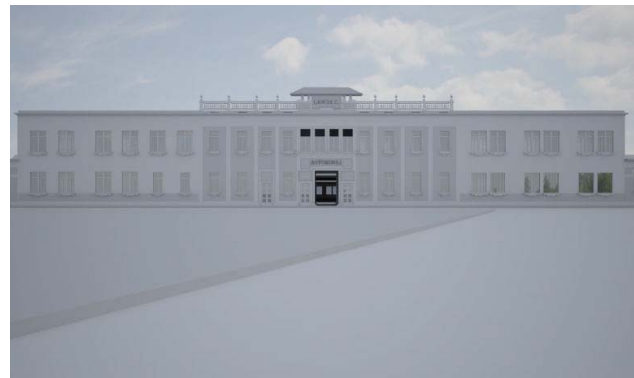

Fig. 13 The main façade in 1918

Construction started in 1911 (see Fig. 12), after a first intervention on the main façade was done in 1918 (see Fig. 13), and finally in 1928, the buildings were completed, as shown in Fig. 14.

The recovered drawing offers an almost complete set of information useful to generate the 3D models depicting the development of the buildings.
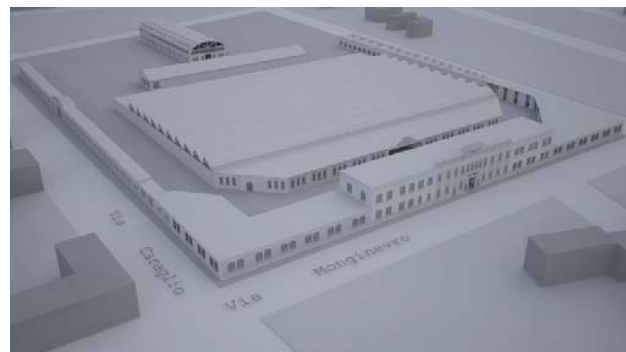

Fig. 14 The LANCIA buildings in 1928

The missing information has been recovered using historical images, knowledge of the construction methods used at that time and logical interpretation.

3D models realized in this way record the information coming from different sources in different layers. In this way, the user can manage the geometric information by correctly considering the different accuracy (difference from reality) of the metric information.

The digital platform collects all the data and visualizes the diachronic change of the building in the context of the urban district taking into account the period identified by the changes of the building recorded by the public offices: in this case, starting from the census and up to the present day condition.
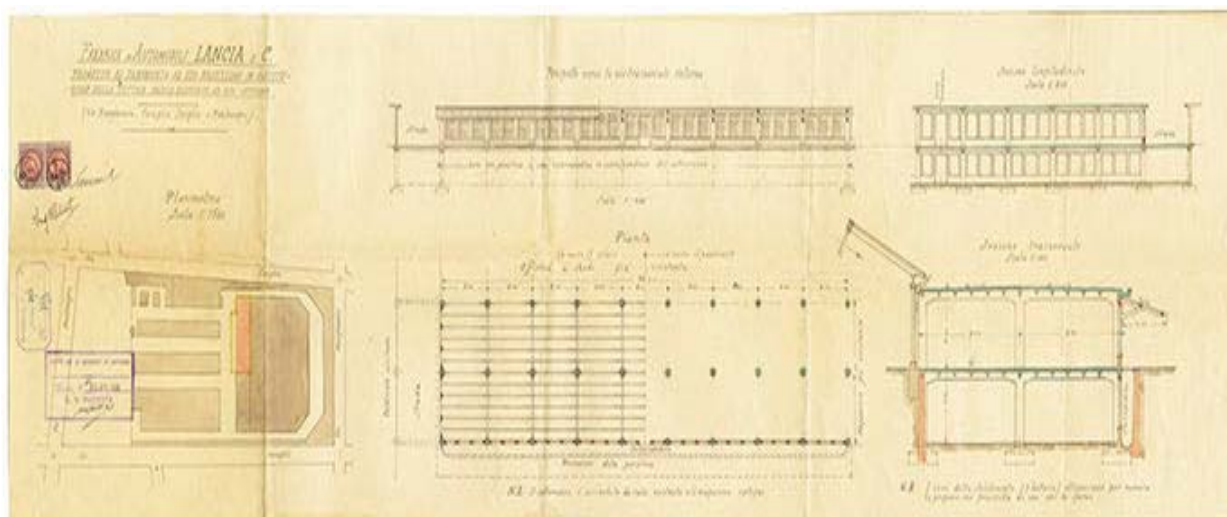
Fig. 15 Drawings preserved in the archives of Turin showing the design of the last renovation of the buildings

Fig. 16 Historical image showing part of the LANCIA buildings in 1911

V. Conclusions

GIS and 3D modelling techniques offer the possibility to store, in a unique logical context, information coming from sources, which offer information with different levels of accuracy and detail. This opportunity is important in a research path where the interpretations need all the possible information of different typologies (e.g. written documents, drawings, images, previous studies, etc.) to be used as a base for a step forward in the knowledge. This approach is especially relevant in our research as the industrial period is a very important part of the history of Turin and of its image. Some buildings disappeared but many others still exist, while others are not represented in the census because they were built after WWI (i.e. the well-known FIAT factory, Lingotto). All of them are part of the city's industrial heritage; although most of them are not protected by a safeguard policy. GIS links the census to the urban space, and the census links the urban space to the people (e.g. workers, owners, and designers).

Digital technologies are, from this point of view, a powerful resource thanks to the capacity to manipulate large amounts of data in a short time and to offer representation tools able to show data and interpretation at any level of detail to support historical information and interpretations.

The digitalization efforts (expensive in terms of time and competencies required for an intelligent transcription of the contents of the archived data) can and have to be shared within the community of potential users.

GIS data can be shared by means of open formats such as shapefiles, while 3D models do not have a format that can be used from any type of 3D modelling software. This interoperability problem is a widespread problem that until now was not able to find an effective solution.

The 3D PDF file represents a possible answer to transmit results. 3D PDF is a format who allows the user to extract the original measurements used to build up the model, to generate sections, to switch on/off the provided layers able to show interior and exterior parts of the realized 3D model.

In both cases (GIS and 3D models), a correct and essential description of the used strategies to define the entities and their attributes and to split the metric information into different layers, is needed to allow for the real transmission of the digitalization efforts.

The census digitalization realized in this context is not a mere transcription of the content, but a real transformation into a knowledge instrument mostly oriented to specific research. The addition of attributes not present in the collected data is one of the possible integrations that researchers need to use in a proper way to better analyse the data themselves.

The census represents in this research, the basic Information System for linking through a map, additional data and data visualization, with the aim of realizing a digital archive.

By considering the referred case of the Survey of London, the Charles Booth Online Archive-LSE http://http://booth.lse.ac.uk/ created by the London School of Economics is a relevant model as a starting point [1], [8].

The example discussed in this work shows what, in the author's opinion, could be a possible second generation of historical archives. All the researchers who use a document have to digitize it its entirety and share it among the

community via a personal website and/or public portals specifically devoted to data sharing. This effort can be "pushed" by archives by offering free access to their available historical documents.

In our research, the integration of the census with other data (i.e. photographs, images, etc.) is due to the nature of the census and to the aims of our research addressed to make accessible an important part of the urban history to different uses/users. Our focus in fact, is also to highlight and provide evidence of an urban image that is fragile and needs to be preserved in today's world.

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