Producing Project

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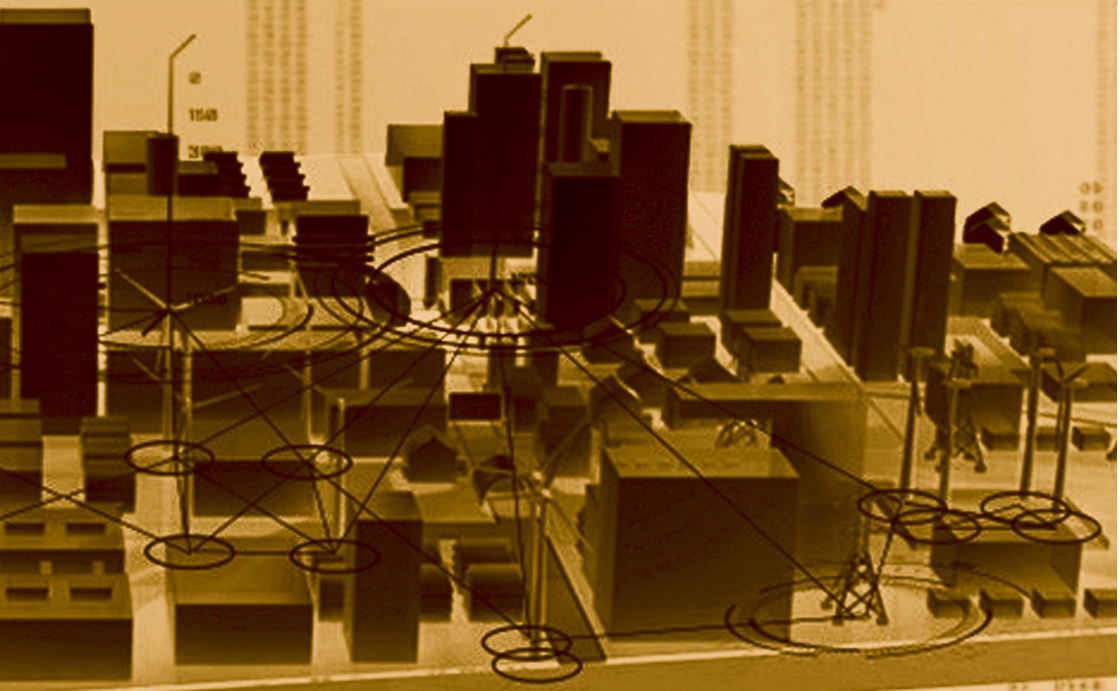

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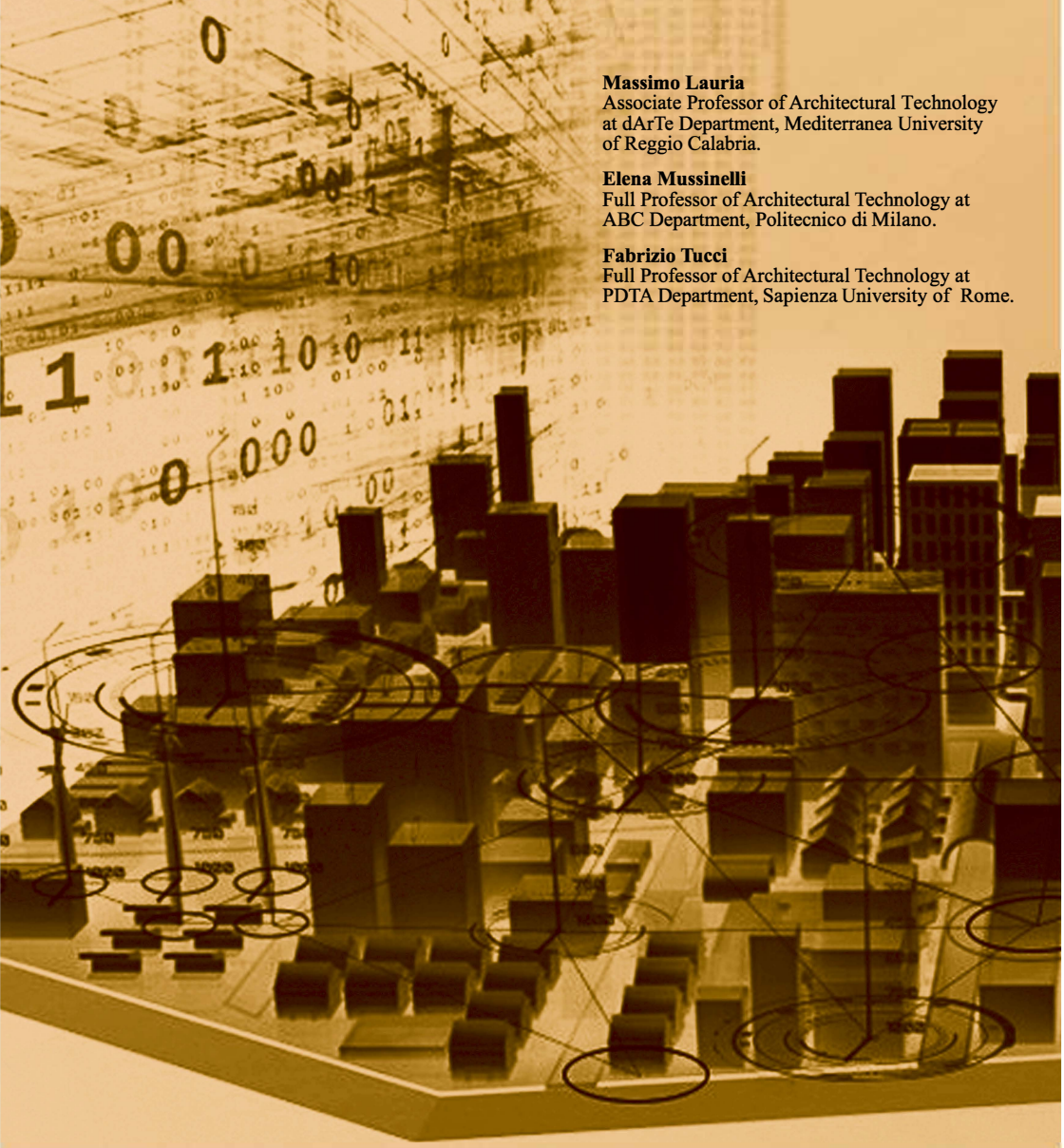

The transformations created about the design activity by the several challenges started by the economic crisis, climate change and environmental emergencies, together with the impact of the Web and ICT on social and productive systems, highlight many critical issues, but also significant prospects for updating concerning places, forms, contents and operating methods of "making architecture", at all levels and scales.
In this context, the cultural tradition and disciplinary identity of Architectural Technology provide visions and effective operating practices characterized by new ways of managing and controlling the process with the definition of roles, skills and contents related to the production chains of the circular economy/green and to real and virtual performance simulations.
The volume collects the results of the remarks and research and experimentation work of members of SIT*d*A - Italian Society of Architectural Technology, outlining scenarios of change useful for orienting the future of research concerning the raising of the quality of the project and of the construction.

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dedicated to
Roberto Palumbo

2.5 WHICH INVISIBLE TECHNOLOGY? METADATES FOR THE RETROFIT OF HISTORIC BUILDINGS

Marta Calzolari[*]

Abstract

The energy recovery of historic buildings is made particularly complex by two critical issues, in addition to the due respect for the principles of protection. The first is the lack of real data on the energy behaviour of the historic envelope, in the absence of a systematic performance survey to create design guidelines. The second is linked to cultural aspects that, as immaterial and "invisible", are difficult to quantify and govern within current management processes, characterised by huge amounts of information made available in the form of numbers. The paper aims to investigate the use of the current digital tools in the retrofit interventions of historical buildings, as a solution for overcoming the two delineated criticalities.

Keywords: Historic buildings, Energy retrofit, Key enabling technologies, Metadates, Invisible technology

The recent revolution in the design and management process

In the past, the prestige of buildings was associated above of all with the client's one; in recent years, however, the «bigness» (Favole, 2017) of the designers gave prestige and fame to the building. Today, in a reverse trend, the value of the building is often associated also with a quality label (sustainability certificate, certificate of energy performance, certification of the used materials). Thanks to the recent innovation of the construction process we are experiencing the rapid replacement of the traditional hierarchical management system: in a parallel with industry, the old structure, characterised by a precise distinction of roles with a top down coordination, as in the Taylor-Ford model (Butera, 2017), is abandoned for a new reticular system in which the result of the process is the interpolation of data, scenarios and strategies.

This trend results in models of intervention where everything is related to reference targets, performance levels, quantifiable data, which allow to choose analytically the best solutions in terms of benefits/costs, according to a binary process, through the use of Key Enabling Technologies.

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Projects are more often based on codified solutions and on standards (related to performances and rules) to be reached.

In the recent revolution of the process (planning and decision-making, as well as management) the operative tools have changed. Therefore, innovation is no longer just the result of the discovery or development of new techniques but above all is determined by the way new enabling technologies are used as elements of mediation, due to a specific need. They become means to prefigure a perspective view of the architectural project (Losasso, 2018).

The research sector is dealing with increasing attention to the elaboration of sophisticated management models with which to interpret the complex construction styles, typical of today's construction sites, and to efficiently use the new materials and the innovative techniques.

L'Internet of Things per il recupero energetico degli edifici storici

The new project management system is offering interesting results for the new construction sector. The question about the influence of the use of these "digital" systems on the processes, still extremely "analogic", of energy retrofit of historic heritage is now interesting, and probably urgent. In fact, the use of Internet tools is frequently associated to the management of cultural heritage, in particular as regards to the improvement of users' fruition, for the increase of the tourism sector, or for the conservation and restoration activities. Assuming the use of these digital processes for the design of energy recovery interventions is still rare, in particular for the choice of intervention strategies or materials and technologies to be used.

The historic buildings have been able to be resilient to the changes over the centuries, but it is necessary to understand how they can react to current decision-making processes. The issue is addressed on two different, but interconnected, thematic levels, which result in a double difficulty in dealing with awareness and respect, but also with the necessary courage, with the theme of the retrofit of historic buildings. The first complication depends on the fact that standardised solutions are not always feasible for the historic buildings and, in many cases, real data and reference targets, that can enter the design platform to best address the intervention, are not presented in an organic form, as for the new buildings. An example, well known to energy retrofit experts, is the text of Law 90/2013 (in implementation of Directive 2002/91/EC, relating to energy efficiency in buildings) in which we read that buildings regulated by the code of the cultural heritage and landscape are excluded from the application of the decree only in the event the judgment of the competent Authority believes that the compliance of requirements implies a substantial alteration of their character or appearance with particular reference to historical, artistic, or landscape profiles (article 3, point 3).

The legitimacy and the limits of the intervention depend, therefore, on the opinion of the Authority, but the lack of a quantification of the level of possible unsustainability of the designed solutions is evident.

Designers have to work with current digital tools, capable of processing simultaneously large amounts of data, but without actually having information to enter into the system, either as input data - the energy behaviour before intervention - both as reference target and abacus of compatible solutions, specifically verified for the historic building. Anyway, for a correct intervention of retrofit of historic buildings, I propose to fill this gap by making use of the tools of the current project production process (sensors, domotics, IoT).

A solution is to set up the design operational databases by monitoring significant historic buildings, selected from those still to be restored, to obtain information on their real energy behaviour before the intervention, and among the already renewed ones, to quantify the performance of buildings during the using phase and to verify the difference between the result obtained from the analytical simulation and the effective influence of real transitory phenomena (users, climatic factors, etc.).

HeLLo[1] project is an example of this possible approach because it aims to detect the hygrothermal behaviour of some types of historic envelope before and after the application of the insulating material (internal coat) to provide professionals, invited to visit the monitoring laboratory and to learn about the tested technologies (participation and dissemination of results), an instrument of knowledge of historic buildings useful to increase awareness for the design of the retrofit intervention. The long-term result of the research aims to create a database of technological solutions, tested and verified specifically for the historic buildings, which is still lacking.

The collection of this information could help to create databases that are constantly updated thanks to the collection of new data, that are targeted to the peculiarities of historic buildings and calibrated on their potential improvement. For example, a sensor system applied to the building with user-friendly interface may increase user awareness (key concept of the smart environment) and it can start a process of constant adaptation between the historic building and the users.

These onsite surveys (environmental monitoring and material analysis) do not need, in fact, only to understand the trend of the envelope's hygrothermal curve or the efficiency of the plants, but also preparing plans to adapt the building performance to the real use by different categories of users.

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[1] *HeLLo - Heritage energy Living Lab onsite*, H2020 - MSCA-IF-2017-EF - Marie Skłodowska-Curie Individual Fellowships. 1/10/2018 - 30/09/2020. Team Host Istitution: Research Centre Architettura>Energia (Prof. P. Davoli, Dr. M. Calzolari) in collaboration with Prof. F. Conato and Arch. V. Frighi, Department of Architecture, University of Ferrara and with Eurac Research Bolzano (Dr. E. Lucchi). Supervisor: Prof. P. Davoli. Marie Curie Researcher (fellow): Dr. Luisa Dias Pereira (Portugal).

Thus, a constant resilience between building and users (through project solutions) is created, and it is possible to trigger an inverse process of adaptation of users to the building (through education to the use of spaces).

This mechanism can lead the users themselves, indeed, to modify the current canons of comfort, looking for a slow, but constant, reconciliation with the past living habits. Moreover, as more frequently recognised, the use of the Internet of Things can be particularly important and useful in the maintenance processes of monumental buildings (for example for the conservation of the artworks or of the decorative setup). The real-time measurement of indoor climate conditions helps, in fact, making a more efficient prevention, quickly detecting any unforeseen hazardous situations or dangerous conditions (for example water losses or condensation).

The archiving and processing of the collected data can also be useful in the long term to create predictive models through statistics and scenarios to anticipate the emergence of problems in the future, based on a deep, consolidated and systematised experience. Although surveying and monitoring systems produce a significant amount of data (thermal transmittance, surface temperature, humidity values, etc.), this information can become a decisive tool for the management of the intervention, only if they are used to study project's solutions, calibrated on the historic building, and not if they remain mere information collected in a digital archive.

The transformation of these "Big Data" into design solutions is the main task of the architect who must continue to manage the process "from the top", precisely because, having replaced the hierarchical sequence with the network, the ultimate goal of the intervention, that aims to enhance the architectural characteristics of the historic building, cannot be lost, because of the fragmentation of the project and the exclusive focus on the performance/quantity aspects of the building. The builders/architects of the past, or congregation components, handed down knowledge to posterity: so it was possible to distinguish the ones who "knew how" from the ones who had not any education and the construction knowledge was based on this system. In the digitalisation era we constantly rely on machines, but they cannot process some information. For example, they are not able to face completely new situations that are not already "in the system". Therefore, to take advantage of enabling technologies, intended as elements of mediation to realise the architectural project, the development of the typically human ability to make connections between concepts that are different and distant, for creating new thoughts (and therefore solutions) never faced before, is necessary (Rinaldi, 2017). Indeed, on the one hand, we urgently have to associate a "datum" with the planning rules, to take decisions that are not arbitrary, assuming that this datum will have numerical substance, but on the other hand this datum will be inexorably linked to a non quantifiable substance, characteristic of historic architecture, which only human knowledge can identify and connect.

This datum, in fact, depends on the other complex issue, still the subject of extensive debate, linked to the project of retrofit of historic buildings. In the case of historic buildings, non-quantifiable values are involved, such as the result of history, of historic-artistic features to be listed, which can not be inscribable to an analytical database: in a word, the result of "culture". The quality of a work of architecture, even more if it is a listed building, depends on this cultural added value linked to the concept of «invisible technology» (Sinopoli, 1997; Kelly, 2011), made of immaterial characters as what we now call "Big Data", but still hardly confined within a precise performance framework.

As Kelly states (Kelly, p. 12), in recent years we are in fact used to deal with invisible and immaterial technology (as software or the use of the internet). However, this is not a new trend because the past technologies that have revolutionised history have often been immaterial, like the alphabet or the Consti-tution. These inventions, as well as the cultural result of human evolution, enter rightfully into all the cultural aspects to be handed down through the current enabling technologies, since the recent design revolution mainly concerns the «digitalisation of the knowledge» (Cerri, Cattaneo, Terzi, 2017). Therefore, the overcoming of the concept of «naked technology» (Colony, 2002) is necessary to enrich the naked technology of cultural heritage and of all information not referable to bits but regarding the complex of values linked to knowledge and to society, to the handed down expertise, to study, to the sensations and emotions that we already recognise to historic buildings through protection. It is necessary to codify the environmental, functional and maintenance metabolism of these buildings, and all the other invisible metadata.

An interactive and open database of knowledge for the retrofit of historic buildings

Data links, to be inserted into the network (of knowledge, but also the more operative of process management), can be created by studying the real historical processes, interpreting them in the most precise way through the convergence of heterogeneous data and extracting some «patterns of repeated events» (De Biase, Pievani, 2016, p. 28) from the multitude of stories. This method makes data available to be involved in the project, in a sort of «taxonomy of monuments» (Maietti, Medici, Piaia, 2017).

Progressively it is necessary to collect and transform in the current communication and work systems as much information as possible on historic buildings, to create a "knowledge database".

The process consists in replacing information with knowledge, meaning the latter as a new awareness, and in making it accessible and open through the database. This digital archive must include aspects related to:

- semantics: the style elements, the morphology, the architectural vocabulary of the elements to trace them and, in the case of intervention, valorised, restored and not lost (Maietti, Medici, Piaia, 2017);
- temporal dimension: the historical and morphological evolution of the building during its life cycle, the transitions and variations in use;
- materials and construction techniques: collecting information on their chemical-physical composition, the way in which they were created and used, the techniques for restoration and conservation is necessary, since there is no manufacturer certificate or the traceability of past products;
- the energy performance, to be able to know and quantify the strategy to enhance it in the design phase with the aim to abandon the current habits to refer to non-targeted design standards;
- opinions, feedback and preferences of end users, detected through surveys and questionnaires, video and sensors;
- the restrictions and rules imposed by the Authority for the protection of built heritage;
- examples of design solutions that are suitable and acceptable for different types of historic building, as a guideline for future interventions.

The portal can be configured as an interactive, additive and open catalogue for the management of all this information that can be easily obtained, in a flexible and shared process. The functionality of this smart system is potentially multiple: spreading information on cultural heritage even to not specialised figures, providing an instrument for planning restoration and valorisation procedures for historic buildings and for giving the possibility to plan extremely specific interventions thanks to a wide experience of real data.

An interesting example, although still limited to the geographical area of Campania, is DATABENC[2], created with the aim of create an integrated platform made up of rules, procedures, good practices and technologies, responding to the smart European model environment, able to help solving some critical situations in which the cultural heritage of the area is concerned.

According to Carr (1961), someone says that facts speak for themselves: but this is obviously false. Facts speak only when the historian makes them speak: historians arbitrarily determine which facts of the past turn into historical facts according to their own biases and agendas.

Just as the historian uses facts as a means of telling the history, the architect, put in the condition of possessing these metadata, can use them as a way to interpret the architecture of the past. Enabling technologies must be used to increase awareness and knowledge, making them as much as possible widespread and shared, so that history can be more or less subjectively understood from different and multiple points of view.

[2] http://www.databenc.it/wp/distretto/.

This «invisible technology» can become manifest through the project: metadata is the clue, while the person who reads and interprets this information has the opportunity to write history.

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