Built environment recovery and maintenance: researches in post-graduate education

Maria Rita Pinto*

The research topics

In recent years, the theme of buildings recovery and management has set as a priority the maintaining overtime of the quality of built and natural heritage, requiring the definition of methodologies, processes and tools that combine the values of the environment, historical memory and innovation.
In this field, the challenge that scientific research is now called to face, is to test new strategies for the exploitation and management of natural and built heritage, ensure the protection of the identity of the existing, preserve its quality and respond to new needs arisen from the use to which the intervention must meet. Main objective of recovery action is to reverse severe processes of obsolescence and mark a new destiny for extra-urban and urban areas, improving the quality of living through the revitalization of the context in which buildings are located. Therefore, the recovery, even when involves limited construction works, marks existing urban tissues, relationships with urban places, the "character" of the areas so deeply that needs to renew the ties and connections modified by the reuse or rehabilitation.
The research for a new balance in the conflict conservation / development of the natural and built environment involves choices based on knowledge, in a process in which technological innovation plays a strategic role and contributes to the management of the complexity that characterizes the natural eco-systems, the built system and the socio-economic system. The comparison between *building and environmental recovery* and *sustainable development* has generated, in recent years, a broad debate on the role that technological innovation plays in triggering processes of sustainable rehabilitation, aimed toward economic efficiency, social equity, environmental protection and preservation of the cultural identity of existing settlements.
In the field of construction, technological innovation must not be tied solely to the product, but rather must invest the decisions and management of the processes of rehabilitation, maintenance, reuse, transformation of the built heritage, by rethinking the procedures, tools and skills involved.
Investigate the potential and the impact that technological innovation related to building renovation can trigger is a key for predicting scenarios in line with the aptitude and potential for market development.
The challenge of upgrading the existing heritage takes different variations with respect to the phases of the recovery process and responsibilities of the actors involved. In the planning phase, it is necessary to reconsider the role of urban policy, in relation to the need to recover the buildings as a network capable of providing public services and putting them back into a circuit of normal availability. In this phase, it is essential to construct evaluative procedures capable of supporting more aware choices of intervention by the project administrators, on the basis of the application of the settlement demand and of the potential of the buildings that have to be recovered. In this scenario, the opportunities offered by the existing legal instruments in Italy for investigating, through the comparison of design alternatives (cf. preliminary project, L.109/1994), utility and convenience – not only economic – of the intervention, are not yet fully gathered. The preliminary project requires greater transparency the evidence as a basis of selection and promotion of dialogue, sometimes not without points of conflict between aims of the owners and needs of users / beneficiaries.

* Maria Rita Pinto, Full Professor in Architectural Technology and Coordinator of the Ph.D. Program in *Building and Environmental Recovery, Maintenance and Management*, University of Naples Federico II, Italy.

In the design phase, the research must address the control of the recovery project, developing the capacity to elaborate appropriate technical and constructive solutions that can integrate and enhance the quality of the building.
In the implementation phase, the research requires a commitment designed to ensure satisfactory outcomes for the intervention. Starting from the project, it is necessary to mark a reversal of current practice in the field of building recovery, which still shows the large amount of material removed from the building, not in compliance with the constraints and the unsatisfactory level of environmental quality and technological results.
During the maintenance and management phase, the research main task is the development of procedures and tools in order to ensure a balance between the "dynamic" system of user requirements and, equally changeable, the building performance. Maintenance acquires the characteristics of a service offered to program and ensure quality preservation. The aim of restoring the "quality" to the built environment, both in terms of storage and growth of values over time, leads to overcome the definition of maintenance as "maintaining the efficiency of the services offered" in order to extend it to the enhancement of the existing resources. In this context, it is necessary to consider maintenance as a culture to be spread on territory, involving the stakeholders who participate in the transformation and evolution of the city.
In this way it is possible to start a coherent path that, through conservation, maintenance and management actions, able to create a system among the needs of natural capital, manufacturing, human and social resources in a sustainability scenario. The maintenance activity is oriented to the reduction of the consumption of resources, by increasing the life of buildings and technical elements and the reduction of the operations of replacement and repair, limiting the incidence of failures in time. In this process, the reduction in consumption of non-renewable resources and energy must be pursued starting from the design phase, selecting materials and components with higher durability, reparable, replaceable, reusable or recyclable. This approach, focused on the recovery process, is based on the relationship among design, performance and life of the products, i.e. projection of choices and ongoing monitoring of outcomes as a challenge to envisage a better future in a sustainability perspective.

The educational path of the Ph.D.

The educational objectives of the Ph.D. *Evaluation Methods for the Integrated Conservation, Recovery, Maintenance and Management of Architectural, Urban and Environment Heritage* are inspired by the "Declaration on Education for Sustainable and Responsible Research & Development" of the G8 University Summit 2009, which emphasizes the key role of University in creating and spreading a culture of sustainable and responsible development. Both training and research play strategic roles in supporting decision making through integrated and trans-disciplinary approaches that promote new models of socio-economic development, based on an appropriate and efficient use of resources. The transition of Europe towards dynamics of sustainable development is highly dependent on the capability to direct the efforts of scientific and technological research towards the definition of new processes of economic and social change, based on the enhancement of trade.
In the third level educational scenario, the Ph.D. contributes to the strengthening of solidarity between cultural diversities, aimed at fostering and promoting local development.
The Ph.D. Program provides training experience that includes the contribution from different disciplines to implement an innovative model based on the idea of a multidimensional natural and built environment constantly evolving and changing, in which activate processes of sustainable development. The synergy between the different disciplinary components of the Ph.D. is an asset to be enhanced through increasingly dense networks of relationships that can meet the challenge of the cities' future. In particular, the Ph.D. Program combines the

economic-evaluated point of view with Recovery Technology to observe and interpret the natural and built heritage in an integrated and interdisciplinary approach. In this scenario, conservation and transformation go together and interact through an innovative approach, in compliance to the cultural challenges proposed by European policies.

The Ph.D. training can respond more effectively to the demand for professionals who, in the field of Architecture, require the capability to plan, interpret, define and govern the process design / implementation / maintenance and management, ensuring quality objectives throughout the life cycle of natural and built systems using the latest innovations.

Furthermore, the aim of tracing a way for original and innovative development through the training activity, acquires special value in the difficult scenario represented by Southern Italy where are simultaneously present areas of excellence and areas of high physical, environmental and socio-economic degradation. These are the result, among other things, of ineffective management and lack of integrated conservation, recovery and maintenance actions. The adoption of new strategies and, above all, the propensity to innovation in processes, products and the organisation of production factors today, requires the involvement of new trans-disciplinary skills to be acquired with the Ph.D.

It is evident the need to activate knowledge systems suitable to the enhancement, governance and management of natural and built resources. These systems can be interpreted as powerful engines to regenerate the physical and socio-economic space of cities and territory in a scenario of sustainable local development. It calls for experimental interventions, even at small scale, based on social consensus and supported by consistent policy of territorial government. The diversity that constitutes the local identity is taken as the base of the redevelopment project, to coordinate the dynamics of global environmental strategies - such as saving natural resources - with the spatial, social, cultural and economic dynamics, specific to a particular territory. This means translating technological innovations into actions and solutions compatible with the existing architectural and landscape systems.

The built context is characterised by a large number of complex conditions, which constitute constraints / opportunities that guide intervention strategies. The evaluation process of alternatives is the engine to stimulate the development of new design solutions, genuinely creative, which can guarantee the quality of interventions.

The redevelopment project is a strategic tool for the economic development because it reduces obsolescence in its various forms (physical, functional, positional, environmental), constituting capacity of attractiveness / enhancement of the area and urban systems thus producing new local and urban values combining conservation and innovation.

The urban and environmental building heritage should not be considered as an unchanging endowment for substance and value, but rather a resource characterised by a fast-growing dynamic which can improve the effectiveness and efficiency in the government of the territory.

The Ph.D. Program is designed to train skills in the field of:

- conservation actions and transformative actions based on knowledge of the buildings,
- technologies of the built heritage,
- analysis of the decay and obsolescence state,
- building and urban recovery,
- building and urban maintenance.

Such knowledge is necessary in order to understand “how” those physical, economic and social structures of a settlement system interact, “which” is the process of evolution that follow “how much”, and “how” are involved in the quality of the recovery, maintenance and management processes. The doctoral thesis, through the case

studies, are used to verify the results of the researches into operations, where it counts also the validity of scientific acquisition and the reformulation of demands for further knowledge. In this sense, the research, based on the interrelation of innovative know-how, will consolidate, in the society and in the public administration, the culture of the planning, proving its usefulness in providing verifiable answers to problems.
The sustainability of recovery interventions can be achieved through an evaluation process that takes into account different approaches:
- institutional assessment of the decisions;
- evaluation as a design tool, which helps to express needs and priorities;
- evaluation as an integrated tool that can help to understand the different dimensions of sustainable interventions.

In the Ph.D. Program the assessment represents the transverse component that allows increasing the areas of tangency of many disciplines represented.
Evaluations are critical and interpretative tools with which it is possible to face problems resulting from the conflict among different goals, identifying priorities among alternative options against multiple, heterogeneous and divergent criteria. Moreover, every design decision raises questions about the choice among alternative options in order to find an order of priorities and the best alternative.
In the case of recovery, the priority is the verification of financial viability that allows to establish the best alternative in terms of lower investment costs and maximization of returns / income in the course of time. The question of re-use is closely related to the definition of the mode of maintenance and management of interventions. It is, therefore, necessary to prepare, for each alternative proposed, a study of the necessary investments and their financing channels – public and private – in the light of the subsequent maintenance costs and possible forms of management interventions.
The regeneration of the cultural heritage plays a central role in guiding the development strategies of cities, designed to enhance / maintain specific local identities in the growing homogeneity generated by the globalised economy. The knowledge advancement in terms of governance / management of the built and environmental heritage, and the research of indicators, expressing the impact of investments in the cultural sector, have also become areas of increasing interest, both national and international. The Ph.D. is concerned with the investigation and the promotion of the research on suitable approaches and tools to cope with the project at different scales (buildings, urban and environmental), identifying opportunities and strategies for recovery and reuse of buildings, able to transform the cost of conservation and regeneration of the built and environmental heritage in sustainable local development dynamics.

Building and Environmental Recovery, Maintenance and Management

Since 2012, the course of studies is called *Building and Environmental Recovery, Maintenance and Management*, and it is a curriculum of the Ph.D. course *Evaluation Methods for Integrated Conservation, Recovery, Maintenance and Management of Architectural, Urban and Environmental Heritage*. It develops research issues related to the existing heritage, aimed at recovering, enhancing, maintaining and managing natural and built resources.
Nowadays, the issues related to the urban and environmental recovery have to deal with a new scientific approach able to mitigate the vulnerability of the cities by using conservation and transformation actions compatible with the heritage to be recovered.
In order to ensure high standards of quality of life in urban areas, it is necessary to promote an multidisciplinary approach capable of understanding the complexities of the natural and built heritage and to guide the

Figure 1: Berlin – Neues Museum, restored by David Chipperfield

transformations in line with a sustainable development. The model of this doctorate, therefore, is based on the complementarity of knowledge, experiences and competences from different scientific domains for the conservation and enhancement of natural and built environment.
By reconciling multi-scalar and multi-sectoral approaches, the doctorate was chosen to connect the building / city / environment network in a design scenario, based on the relationships among characters, spaces and instances of users. As part of the decision-making processes, the urban and building rehabilitation proposes the development of alternative intervention scenarios as tools for choices construction, clarification of interests and values at stakeholders, exploration of the elements characterising the identity of the territory in which it intervenes.
The scenario becomes a tool for decision making, able to integrate approaches, methodologies and models, with reference to the specificity of the operation site and the actors involved in the processes of territory transformation. Through the instrument of the scenario, it is possible to interpret, predict and compare the impacts of various actions in relation to specific enhancement objectives.
The dialogue between recovery technology and evaluation is able to play a specific role in improving the quality of the landscape and governance, through the production of new values.
A process of integrated assessment stimulates the identification and the investigation of new creative options. In this case, the complexity of the economic, social and institutional alternatives compared to the multidimensional structure of recovery, can produce scenarios able to generate new values.
In fact, the Recovery Technology has its objective in the recognition of the existing values and in the production of surplus values through the project, in which the evaluation permits the identification of the priorities, especially in

the case of conflicting targets. The evaluation will focus not only on the analysis of the environmental, economic and social aspects, but will also consider the intangible elements and components (i.e. the culture and the creativeness) that influence decision-making in cities now subjected to rapid changes.
As a consequence, the strong connections between the two training profiles that characterise the doctorate (Evaluation and Recovery) emerges. The doctorate, in fact, combines the evaluative point of view with that of Recovery Technology to observe and interpret the changes and possible scenarios in an integrated and interdisciplinary vision.
The Historic Urban Landscape (UNESCO, 2011) is the unifying perspective of the different disciplinary specialisations involved, and its different components have been investigated in the meaning of landscape dynamic.

Figure 2: Berlin – Neues Museum, restored by David Chipperfield

The research conducted by Ph.D. students has the objective to develop knowledge and governance systems of processes related to regeneration, reuse, maintenance and management of natural and built resources, with the aim to preserve and improve performances in the respect of their identifying characteristics. The doctorate is, in addition, an opportunity to deepen, inside University, issues related to the project of the existing heritage, according to the different involved dimensions (building, urban and environmental).
The investigation of the potentialities and strategies of recovery, maintenance and management of buildings requires methods and tools to regain the initial efficiency of the proposed services and to introduce new performances. Indeed, the scientific contribution is oriented towards the elaboration of innovative systems of knowledge and the support to the decisional process, based on multi-scalar and cross-disciplinary inputs.

In particular, the specific feature of the Ph.D. is the co-presence of multiple scientific areas, against which the assessment links the individual skills involved in the recovery project, articulating responses in training careers and operational tools. The intervention in the natural and built environment requires strategies to resolve the conflict between conservation and development, in a process in which the evaluation plays a critical role and helps to take into account the complexity of structures and operations of natural and social systems involved, and of costs implicit, indirect and external.

The Ph.D. in *Building and Environmental Recovery, Maintenance and Management*, in particular, trains experienced researchers in rehabilitation, reuse and maintenance of the built, urban and environmental heritage, characterized by the ability to combine knowledge from other fields. The professional profile of researchers has been outlined with the aim to meet the specific needs of public agencies of Local Government, public and private research centres, associations and organisations owners and /or managers of Real Estate operating in Italy, with reference to the following topics:

- **Analysis of existing constructions, innovative materials and technologies for the recovery** with regard to traditional and modern building techniques, structural conceptions, morphological, functional and distributive characters of ancient and modern buildings, states of decay and role of new materials and innovative technologies in the field of interventions on the built heritage.
- **Management process of building, urban and environmental recovery** with regard to the character of the intervention process on buildings, the skills and the actors involved in the management of technical and the economic and normative resources for recovery in order to ensure quality.
- **Maintenance of the built heritage, urban spaces and territory**, with regard to evaluation methods for planning maintenance strategies aimed to the conservation and enhancement of the built heritage.
- **Urban and environmental regeneration,** with regard to the approach of the urban and environmental regeneration, combining functional and economic needs with the preservation of the identity of places. The quality of the areas of intervention can become the starting point for innovative strategies for local development if the management of transformation and conservation takes place in a systemic perspective. Indeed, sustainable development requires a unifying perspective of governance that can improve resilience by promoting smart networks of reciprocal interactions dedicated to the city or territory and understood as complex dynamic systems.

In the field of maintenance, it should be noted that the research activities are supported by the Laboratory of Reuse, Rehabilitation and Maintenance (LRRM), University of Naples Federico II, at the Department of Architecture, which obtained the quality certification UNI EN ISO 9001-2000 for the development of “Operational procedures and tools for building maintenance”.

The research work conducted during the Ph.D. is characterised by the desire to translate knowledge into methods and tools for the intervention administration (regulatory and procedural tools, operational techniques, etc.) aimed at ensuring and increasing the quality of the existing built heritage.

The lack of professional roles with specific expertise in the field of building and environmental recovery, nowadays seems particularly critical in the context of Public Agencies, being engaged in planning and defining strategies for territorial and urban centers development. Depending on this need, the educational experience gained during the Ph.D. aims to answer the demand for new skills and highly qualified professionals. Indeed, they must be able to develop methodologies and tools in order to ensure high quality levels in the planning, design and management of the recovery.

The doctoral thesis addresses the issue in a multi-scalar perspective (building, urban and environmental scale),

by investigating potentialities and strategies for the recovery, maintenance and enhancements of the built environment. The continuity among community, city and the building is the foundation of the curriculum, identifying in the relationship between architecture and environment the main element of the landscape-system.
The organisation of the didactic activities of the Ph.D. Program is designed according to the specific contents of the course and in relation to the resolutions as part of the Ph.D. Program in Architecture at University of Naples, in order to promote joint activities with other doctorate courses, while respecting the disciplinary differences and the original autonomy. In particular, the training organisation has been structured according to a three-years course of progressive deepening of the research themes, which provides basic training, specialised training and the development of a thesis.
The Ph.D. Program is organised on an offer of two main blocks: the training activity - divided into teaching courses and specialised seminars - and research activities.
The spirit of the Ph.D. is to foster the gradual emancipation of a science graduate student who - once gained the logical tools and methods necessary to complete the research - proceeds in the articulation of its own training program designed to investigate the specific topics of the thesis. According to this principle, the experience of the Ph.D. research is considered the first step towards the definition of a personality with independent scientific and highly specialised skills, allowing students to take critical references and develop methods and tools capable of characterising their profile in the scientific community. Therefore, to the scientific production of graduate students is assigned a significant weight, urging - over three years - to publish in journals, participate in conferences with their contributions, attend internship with Italian and foreign research centres, gain experience of research abroad, create personal relationships with the international academic world (networking). In this perspective, the same research of doctoral candidates evolves by types of activities assisted (I and II year) for individual research activities (II and III year).
The first year course is aimed to provide the basic elements of knowledge covering the topics of the Ph.D. Program and to start training in scientific research. Compared to the first of these objectives, learning activities are designed to outline in a critical way the cultural and operational scenario, in which doctoral issues and open lines of research are highlighting the complexity of the processes of recovery, maintenance and management of built heritage, urban context, the system of landscape and environmental resources.
The contribution of teachers belonging to the Graduate College, of national and international academics personalities, of government agencies experts and representatives of the professional world, contributes to the definition of the trans-disciplinary profile of the students; the curriculum is enriched, moreover, by the participation of representatives of public and private research institutions and companies and associations working in the industry and manufacturing.
With regard to the research training, activities are planned in accordance with the Doctoral School in Architecture at University of Naples, providing joint courses on specific methods of international research in architecture, courses related to the bibliographic research and seminars on topics that affect the different courses of the Doctoral School in a transversal way. Starting from the first year, the teachers play a fundamental role, acting as tutor for the students.
This activity aims to contribute to the development of theoretical and methodological tools necessary to enable the definition of a cognitive path of the recovery project. From the first year of the course, students work together into departmental researches related to the doctoral issues and become main elements of the ongoing relationships with national and international personalities and organisations. This allows to program and evaluate the opportunity to study abroad or at other research centers all over the country.

At the end of the first year of the course, students draw up a final report, outlining the research project that they intend to complete and demonstrating good knowledge of the topics of the thesis (from the analysis of the state of the art of the chosen research area surveying existing technical and specialized literature, to the definition of the bibliography, the identification of phases, methods of research in relation to similar experiences, both in Europe and outside Europe).

The second year course is aimed to specialised training: doctoral students participate in school activities, integrating the attendance of scheduled courses in the doctoral program with a targeted contribution to the deepening of the topics discussed in relation to the specific research orientations. These contributions from different scientific institutions are directed to provide qualified expertise on issues related to the thesis topic. In order to start the research thesis, students are encouraged to create internships with public and private research institutions in the local area and in foreign Universities. Following the work carried out during the first year, students are involved in departmental researches related to the thesis proposal and encouraged to participate in national and international seminars and conferences with contributions and publication of the Ph.D. research results. For institutional integration of educational activities, the Ph.D. has enabled, over the years, numerous opportunities for exchange and workshops held at both academic and extra-academic, italian and european, with the intent to encourage the training of researchers aware of the methodological and operational tools related to their field of research.

The third year is dedicated to the conclusion of the individual research work through the verification and validation of the model proposed, the methodology and the tools employed. The student writes-up the thesis and a large part of his time is dedicated to his individual activities and in meetings with tutors, regularly reporting the research progresses to the Board.

The transition from a culture of resources consumptions to one directed to their recovery and compatible transformation represents a main point in the strategies implemented within each individual research work.

The quality of the recovery process can be ensured only through a scientific approach that favours complementary actions among knowledge, experience and expertise of its different domains, for the preservation and enhancement of the natural and built heritage. It follows, therefore, the request for training researchers prepared to deliver world class skills, independent critical thinking skills and high degree of specialisation, able to fit into the network between industry, business, production sectors, technological research, strategic community policy and actions of local government.

The conservation of resources is closely linked to the objectives of sustainability and requires professionals to govern actions careful, and continuous recovery / maintenance / management over time of natural, manufactured, social and human capital, through methods and tools that enable sustainable development processes at the local scale.

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