Innovation in research
The challenge and activities in progress
L'innovazione nella ricerca
La sfida e l'attività in corso

Materiali del IV Seminario
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edited by
Orio De Paoli and Elena Montacchini

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Proceedings of IV Seminario OSDOTTA
Turin, 10 – 13 september 2008

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Topics and Results

Daniela Bosia[1], Gabriella Peretti[2]

Research and innovation

On the concept of innovation

The year 2009 has been proclaimed the European Year of Creativity and innovation. "The initiative aims at developing the importance of creativity and innovation, as key skills for personal, social and economic development. It also aims at sustaining the European Union in the challenging process of globalization. One of the issues that demands immediate attention is the environment, which as well as being a precious resource in need of the utmost care and protection, can also represent a strategic resource for economic development".

Creativity and innovation contribute to economic prosperity and to individual and social well-being: this is the key message of the European Year of Creativity and innovation, that has as its main objective that of "promoting creativity through constant learning, seen as the engine of innovation and playing a key role in the development of personal, professional, entrepreneurial and social competences, as well as the well-being of all the individuals in society".

The 2008 Osdotta seminar chose innovation as a theme for the doctoral candidates' work, also taking into account the international outlook of this event.

It represents a thinking cap on the trends that have characterised research, particularly on technological innovation, in most recent years.

[1] Politecnico di Torino.
[2] Politecnico di Torino.

It also analyses current emerging problems in order to define a scenario of tentative objectives and to intensify a debate with external interlocutors. This is both a subject and a problem that has always stimulated our discipline and the research in the various scientific areas involved.

The theme of innovation is tied to the concept of creativity, intuition, invention and development. It is also deeply influenced by the socio-political and economic relations it emerges from. The newest element in a creative process today, compared with the past, is the fact of working in a team, where different skills, experience and tools meet and interact in a very complex process, whilst in the past the inventor was usually 'alone'. When talking of innovation and referring to the field of architectural technology, we're dealing with "a research for mediation between technical and scientific knowledge and the specific values of architecture. That is to say the social, psychological, anthropological, aesthetic and built environment aspects." This mediation must in any case take place according to a rigorous methodological system that represents the specific element of our discipline".

Invention, that comes from an intuition in its first phase, and is linked to creativity which characterises human beings, becomes innovation when exploited in a specific social, economic and environmental context, and engenders an idea of development. N. Rosemberg explains the passage from invention to innovation very well, saying that 'in the prenatal phase of innovation', a trajectory is set through the context where invention develops and proceeds on an arduous path of great complexity.

The general concept or innovation has also an economic origin as well as a technical and scientific one and lies at the basis of studies and entrepreneurial development strategies.

According to J. Shumpeter, whilst invention consists in perfecting a scientific type of knowledge, innovation also includes the circulation and use of innovation, be it a product, a process, services, organization or market.

Innovation can in fact take different profiles that become more specific and articulate depending on information and communication, but still with complexity as its main scenario, while research and development are its promotional tool.

Innovation, which may be considered one of the leading elements of the so-called "Lisbon strategy", according to the general definition of the European Commission, consists in fact "in the production, assimilation and successful exploitation of new economic and social

strategies" and can be reached through the "renewal and expansion of the range of products and services, together with the associated markets. It also coincides with the use of new productive methods, supply and distribution, the implementation of managerial changes both in the organisation and in the working conditions, as well in the qualifications of the workers".

For the European Union, research promoted by what is commonly defined as R&D activity, provides a fundamental contribution to innovation, especially when tightly linked to the entrepreneurial world. Among the indicators to evaluate innovation, a important role is played by the investments in Research and Development, together with the number of patents and scientific publications.

As underlined in the *European Commission Communication on innovation Policy: updating the European Union's approach in the context of the Lisbon strategy* (2003), innovation is much more than just the successful application of the results of research, therefore innovation policies must not only focus on the relationship between innovation and research. The concept of innovation has evolved in time, moving from a linear model where research and development are the starting points, to a more structured and systemic model, where innovation is born and develops from complex interaction among individuals, organisations and their working environment.

The increase in the systemic nature of the innovation process and the variety of the roles that contribute to the making of and circulation of a new scientific and technological knowledge, allow us to apply the definition of "innovation systems" to groups of enterprises (both small-medium and big), governments (central and local), universities and public and private research centres. All of these participate together in the making of innovative processes (cfr. *Preface*, in F. Crespi (edited by), *Annual Rapport on Innovation 2008*, COTEC – Foundation for Technological Innovation).

Other than the close relationship between research and innovation in the entrepreneurial field, which leads to the so called *technological innovation (of the process or product),* that is to say innovation derived by research, according to the parameters of the European Commission, innovation can also be organizational. This would include *innovation in relation to commercial models,* that admits that a new way of organising the working force in sectors such as work force management, distribution, financing or production can have a positive influence on competitiveness. The expression *innovation of presentation* is used as

a general concept that includes innovation in sectors such as design and marketing.

In general, innovation can be considered as the application on a vast scale of an invention, and can manifest itself in different ways, such as the exploitation of an invention that came from research or from re-proposing ideas, products or processes used in other sectors. This invention would operate by analogy, with "transference of fields", as happened in the construction sector, i.e. in the application of industrial methods to construction.

As well as looking for new markets, with low technological impact innovations, or of new commercial organizations, innovation can also re-use already existing and known materials.

This is an implication of technological innovation that is largely applicable in the field of architecture and gives ample room to research.

The theme is not new in itself, as can be seen in a 1931 issue of "La Casa Bella". Compressed straw panels were accompanied by such words as: "among the materials that help create a new and modern home, some are but a modern and intelligent re-use of old and very common systems, simple and practical ideas that have been taken by contemporary technology and industry and launched on the market". In those days the autarchic economic system was setting foot in Italy, and greatly encouraged research in the construction field.

These words seem particularly modern if we think of the research scenarios that environmental issues have prospected as solutions. On the one hand they are have a high technology content, exploring highly specific sectors such as nanotechnologies, on the other hand they re-propose appropriately adapted traditional technologies and materials, such as straw, earth, wood, with an almost direct passage from tradition to innovation.

The relationship between research and innovation

The basis for a research activity must be, without doubt, an original starting point, dictated by the intuition of a new unexplored direction that will lead to innovation. In this sense a tight relationship between research and innovation can be established. When starting a research, the first operative phase consists in a detailed analysis of the state of the art on the topic we want to study to acquire the knowledge of unexplored spaces of the theme which is of particular interest to us. Another interesting aspect of the research-innovation combination is

that when a research is started, and with it a process, starting from the questioning phase, we don't know what the next step or the results may be, but a methodology is established in the first place, and we can only just catch a glimpse of the field in which results will be found.

Because of the sum of aspects in the field of research and innovation it is necessary to have courage and a vision of the future that must be different from the standard one. We need to explore the potential of new knowledge and accept the influence of imagination, which are all elements that are tightly tied to the concept of creativity and intuition.

In the field of research the final phase is also important, that is to say the circulation of the results. It is especially important for results not to remain within the walls of the academic world, but that there should be a real and profitable circulation of results specifically because of the lapses that they may otherwise encounter in future strategies. Of course, methods and means of publicising vary according to the context, but rely more on the production market rather than the public sector or specific private sectors. The theme of the circulation of research results is tightly connected to the role of the various purchasers who constitute the first interlocutors for researchers. During the Osdotta seminar, we tried to tackle this theme because of its great importance, and to bring doctoral candidates to test themselves and the products of their research with possible purchasers.

Even research method, a theme that has been largely debated by doctoral candidates during this seminar, is of great importance.

Considering the two theories of planning and design of innovation, that is to say the principle of – *demand pull* and *technology push,* according to which innovation derives either from a market demand that stimulates it or by the research itself that increases knowledge and proposes it to the market, it is obvious that, given the complexity of the theme of innovation, the two theories coexist.

We must also take into consideration the fact that the construction sector is characterized by great slowness which is due both to the diverse responsibilities and by their distribution in time and space. Part of this slowness of the innovation process can also be ascribed to construction planning, by nature a conservative field, little informed and at times decidedly static, little inclined to give innovation new impulse. Another responsibility is due to a culture that is too specific in the industrial context. All these factors unequivocally weigh upon an innovative development in the field of architecture, and more generally in construction, and demonstrate how technological innovation must

be born from a general knowledge that should also be intra-sectorial and must be nurtured with specific managerial tools to modify both the product and the productive process, the relationship between the firm, the business and the market.

The challenges that innovation research sets in contemporary society are also obvious in the themes of the research undertaken in the various research doctorates that deal with Architectural Technology. Further thought could however turn out to be useful, such as the reinforcement of interdisciplinary dialogue in the research work done by doctoral candidates (an interdisciplinary process in order to produce innovation – be it the product or the process – is nowadays inevitable and evident). Other points are the accurate exploration of "technological places" to direct the choice of the theme, contact with productive reality and with the market, with its needs, its limits, its tendencies and the dynamics that distinguish it, and the comparison with an international or at least European perspective on research.

Learning by doing is possibly the method that is most suited to doctoral research in architecture: one learns to do research by researching, one learns more by mistakes than by success. We sometimes have to change course, to adapt to new conditions or "perturbations" with route changes that are also significant. We sometimes follow an idea without having verified that others may have had it before us… on the one hand the 'rigour of the approach' remains constant, on the other, poetic intuition still plays its role.

This is the challenge we must give our doctoral candidates.

Orio De Paoli[1], Elena Montacchini[2]

The experience of the fourth Osdotta seminar

The principal theme of the fourth edition of the Osdotta seminar, which was held in Turin from 10-13 September 2008, was innovation in research as seen through the methods used and the contributors reporting on the results of the research. In comparison with the previous editions there was an important new element in the final round table, namely that the session was opened also with the presence of three prestigious valuators who are external to the technology sector: professors Ezio Andreta, Lorenzo Matteoli and Mario Rasetti.

The purpose of the seminar was to overcome the self-referential characteristics that may emerge when the discussion remains purely within the discipline of Architectural Technology, and to be open to a different perspective determined by the analyses that the external invited valuators developed during the discussion which followed the presentation of the doctoral candidates' work.

The program of the three days of meetings developed, as in the preceding editions, with discussions on themes defined in the preliminary meetings in preparation for the seminar, conducted by the doctoral candidates with the contribution of tutors and with the final presentation of the work and then the final round table that hosted the discussion and the verification of the three external valuators.

The text reports the results of the activities carried out during the seminar, defining the work of the different discussion tables carried

[1] Politecnico di Torino.
[2] Politecnico di Torino.

out by professors, tutors and doctoral candidates and the contribution of supervisors external to the discussion on research and innovation. Moreover in the first part it contains contributions from various professors in the Technology area on several considerations pertaining to the research doctorates in our sector.

The publication is divided into three principal parts:

- *Part I* - Doctorate in Construction Technology: approaches and research method;
- *Part II* - The challenges of innovation;
- *Part III* - Innovation in Construction Technology Doctorate: OSDOTTA _08

In the first part we want to pinpoint the aspects that characterize the innovation of the Research doctorates in Architectural Technology from the point of view of organization, content and method. A few essentials were identified, such as the importance of the Internet for the dissemination of the results of research on a national and international scale, the inter-university organization of doctorates, the interdisciplinarity of areas relating to the same doctorate.

The second part illustrates the current scenario and the future challenges on the theme of innovation, specifying the strategies that research must tackle in the coming years.

Through the contribution of experts who took part in the seminar's round table, indications are given for possible research: strengths and weaknesses in the field of research in Architectural Technology (contribution from L. Matteoli), strategies and methods of approach in European research (discussed by E. Andreta), aspects of innovation in doctorates in Italy (contribution from M. Rasetti).

The objective of the third part of the text is to identify the results and problems that emerged during the debate on themes proposed to the doctoral candidates, in each discussion table on the theme of innovation in the construction sector. This part is divided into five sections, one for each discussion table: Innovation of dwelling patterns: building structures, Innovation of living in the urban and regional scale, Innovation of product: materials, components, systems and construction process, Innovation of process: design methods and tools, Innovation of process: methods and tools for evaluation, quality control, and management.

Each section has been structured on the basis of a methodological synthesis of the contributions of the participating lecturers and a

presentation of the results that emerged from the doctoral candidates' discussions. In addition, the publication provides an appendix with the synthesis of the research carried out by the cycle XXI doctoral candidates.

This seminar, like the previous ones, with all the difficulties that emerged and were discussed with the external valuators, has been a positive experience for the doctoral candidates who took part in it, not only because of the enriching work around the discussion tables, but also for the information provided about the research carried out in the various universities in terms of contents, methods and observations about the role of research in the university in relation to external contributors.

Daniela Bosia[1]

Data on the participants

One hundred and thirty doctoral candidates, with fifty lecturers, from fourteen universities and twenty doctorate programs, participated in Seminar IV OSDOTTA_08 of the network of research doctorates from the scientific disciplinary sector of the Technology of Architecture.

The greatest number of doctoral candidates came from the Politecnico of Milan, with 27 candidates from four doctorate programs: 6 from the Doctorate in "Programming maintenance and requalification of building and urban systems" (PMT), 6 from the Doctorate in "Technology and Project for the Constructed Environment" (TPAC), 8 from the Doctorate in "Technology and Project for Environmental Quality" (TPQA) and 7 from the Doctorate in "Project and Technologies for the Valorization of Cultural Property" from the center in Mantua. The Doctorate programs that registered the greatest number of participants are the Doctorate in "Technology of Architecture" (TA) of the University of Ferrara, with as many as 21 participants, followed by the Doctorate in "Technology of Architecture" (DOTTA) of the University of Florence, with 17 participants.

The participation of doctoral candidates from the centers in Naples was also good: 15 from the University of Naples "Federico II"– 10 candidates for the Doctorate program in "Technology of Architecture" (TDA) and 5 for the inter-university Doctorate in "Building and Environmental Recovery" (REA) – and 3 candidates for the Doctorate

[1] Politecnico di Torino.

in "Technologies of Architecture and the Environment" (TAA) of the Second University of Naples.

The host institution, the Politecnico of Turin, participated with a total of 13 candidates, of which 12 from the Doctorate in "Technological Innovation for the Constructed Environment" (ITAC) and 1 from the Doctorate in "Architecture and Building Design" (APE).

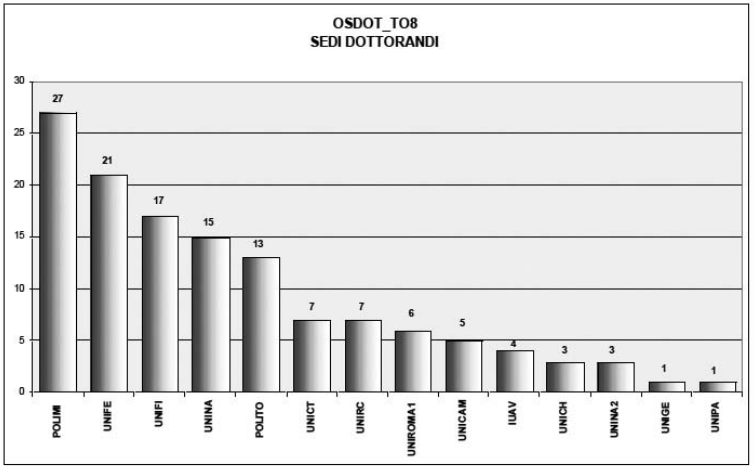
In descending order, finally, the participation of the other doctoral candidates of the OSDOTTA network: 7 candidates from the Mediterranean University of Reggio Calabria and from the Siracusa center of the University of Catania, 6 candidates from two Doctorates from Rome La Sapienza (4 from the Doctorate in "Environmental design" (PA) and two from the Doctorate in "Requalification and recovery of installations" (RRI)), 5 from the University of Camerino, 4 from the IUAV, 3 from the University of Chieti-Pescara and 1 from the centers of Genoa and of Palermo.

The participation of doctoral candidates with respect to the cycle of the Doctorate showed a preponderant presence of cycle XXII and XXIII (corresponding respectively to 36% and 40% of the participating candidates), a reduced presence of cycle XXI (22%). Since cycle XX is in the process of being phased out, the limited presence of candidates from this cycle is justified.

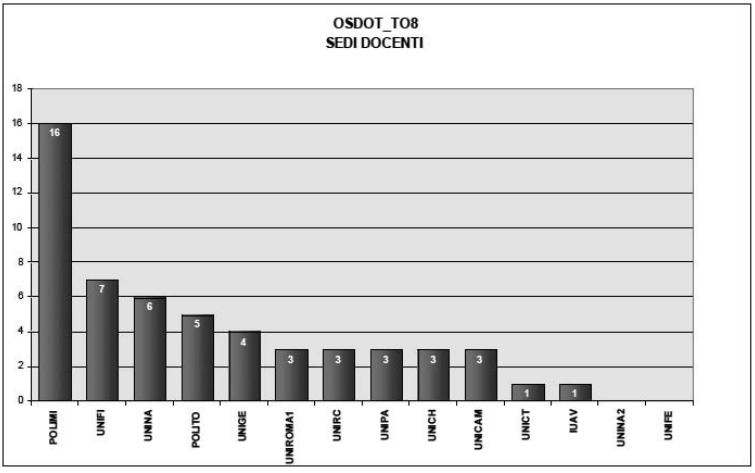
The work of the candidates was organized in five "work tables", under the tutorage of over fifty lecturers:

1. Innovation of dwelling patterns: building structures;
2. Innovation of dwelling patterns: urban areas, land and infrastructures;
3. Innovation of product: materials, components, systems and construction process;
4. Innovation of process: design methods and tools;
5. Innovation of process: methods and tools for evaluation, quality control, and management;

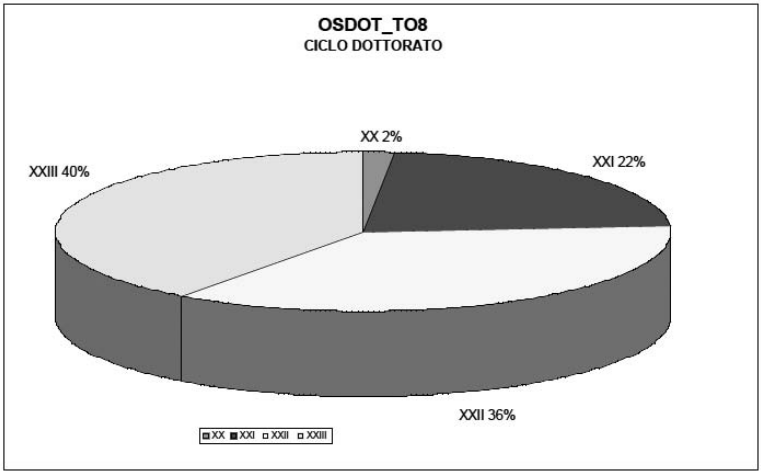
It appears clear that research themes on innovation of forms of habitation and of innovation of product dominate over those of innovation of process.



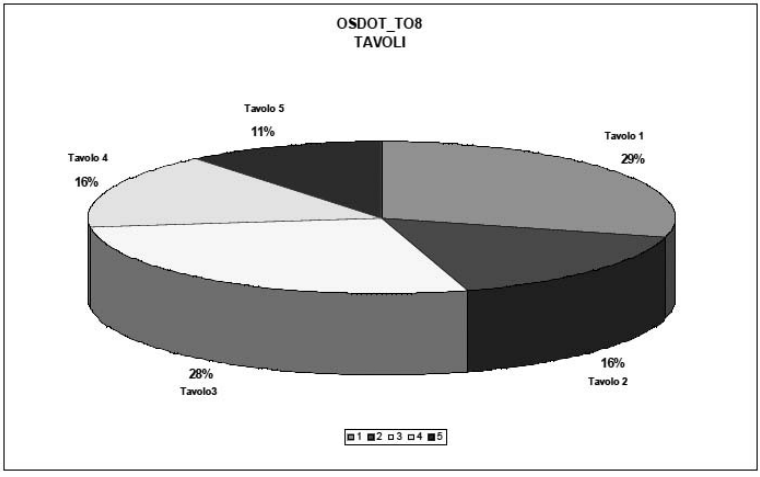
Distribution of doctoral candidates by location of the institutions of their Doctorate



Distribution of lecturers by location



Distribution of doctoral candidates with respect to the cycle of the Doctorate



Distribution of doctoral candidates in the five "work tables"

PART I

Doctorate in Construction Technology: approaches and research method

Maria Chiara Torricelli[1]

Theory as an engine of innovation. Strong point of doctoral research

Mario Rasetti, in his report to the OSDOTTA seminar on doctoral training for research, underlined the distinction between research as an original production of thought and knowledge, and research targeted at development and transfer. Rasetti declared that the specific role of the university in the field of doctoral training is first and foremost to train for the original production of thought and knowledge. This statement has struck me particularly, both in the context of my experience of coordination of the doctorate for some years now, of tutoring doctorate theses and of participation in final examination commissions in different seats of doctorates pertaining to the OSDOTTA network.

I wondered what contribution to the production of original thinking was provided by researches in connection with the thesis (the culminating moment in training and production of results in doctorate courses), in particular in relation to the technological disciplines of architecture. And further: how this originality, so declaimed in the criteria of judgment in connection with the final examination, could be identified and evaluated, and to what capacities it could be ascribed. Last but not least, I wondered if it was a capacity truly useful to the doctor in research, with regard to possible career outlets.

Reflection becomes necessary at this point, also as a result of the determination, universally declared, to draw up a balance sheet of the experiences gained thus far in the OSDOTTA summer seminars, with a view to passing on to a second phase, following the start-up period

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represented by the first four seminars focused, in two cases, on how research is done, and in the other two, on the priority challenges that research should face up to, namely:

- Creativity and innovation in research, I OSDOTTA Seminar – Viareggio 2005
- Innovation and mobility for research II OSDOTTA Seminar – Pescara 2006
- Research faced with the environmental challenge, III OSDOTTA Seminar – Lecco 2007
- Research faced with the challenge of innovation, IV OSDOTTA seminar – Turin 2008.

The thesis that I propose here for discussion is that of a re-evaluation of the innovative role of theory.

Training for research in the architectural technologies: a question of practice or theory?

The technologies of architecture are design disciplines which deal with the built environment. From the point of view of theoretical and methodological apparatuses, research in the area of architectural technologies belongs to the multidisciplinary ambit of the *design sciences*[2]. In this ambit specifically the *technical sciences*, are marked by recourse, among others, to prescriptive theories, in the sense of theories that propose solutions to problems, rather than explaining, predicting or narrating[3]. Design methodologies originate from these, aimed at introducing into reality new or innovative facts meeting the determination of making modifications in the positive sense, as an expression of a know-how based on theory, experience and practical wisdom (*episteme, techne, phronesis)*. The project is fuelled by inventive and creative capacities, but also calls for transparency, communication, and clarity transferable and evaluable in order to be understandable. So that there is a problem of concepts and methods on which to base the project. As it becomes more and more complex, the project of the built environment has

[2] "Scienza del progetto di architettura: nuovi paradigmi di ricerca. Riflessioni sui temi di Palazzo Vegni" in *Ricerca Tecnologia Architettura un diario a più voci*, a cura di M.C. Torricelli e A. Lauria , Edizioni ETS, Pisa 2008.

[3] Simon, H. *The Sciences of the Artificial*, MIT Press, Cambride, Massachusetts, 1969.

seen the origination of a fragmented know-how, divided according to competences, disciplines and permanent posts. The exceeding in a collaborative and shared way of such a fragmentation re-proposes in new terms the problem of the common theoretical terms of the project disciplines in the built environment.

From the viewpoint of training for research, the question which then arises is not whether today it is necessary or possible to conceive of the doctorate as a basic training for research in Technology of architecture, through paths that contribute to building, validating and trying out an apparatus of theories to which technical know-how and project practice can be traced back.

It is interesting to evaluate the different implications of the question: can one speak of a theory of the architectural project, is it necessary? Can one speak of a theory of the built environment project, is it necessary?

In answer to the question on the theory of the architectural project, I would quote something written by Carlos Martì Arrìs[4] in his essay "Centring and the arch" leading back to the more general question: is objective and transmissible knowledge in the field of artistic activity possible? For Martì Arrìs the answer is 'yes', but attention must be paid to not confusing theory with doctrine, and concepts with norms or rules. "The task of theory is that of widening the practice of the project and its problematic field, at the same time providing instruments which enable us to pose such problems with greater clarity and correctness, that is to say, which make it possible to recognise more tidily the complexity of the real". However Martì Arrìs maintains a distinction between theoretical knowledge in the natural sciences and theoretical knowledge in art and architecture, since the former is of "an accumulative and progressive nature" and the latter of "more of a cyclic and persevering nature".

In the specific case of the field of action of the disciplines of Technology of architecture it appears more congruent to pose the question in terms of: theory of the built environment project, meaning by this concept the system of artefacts, organisations and procedures, and the environment in the broad sense. I will refer in this case to what Lauri Koskela writes in an editorial of the issue of

[4] Carlos Martì Arìs, *La centina e l'arco*, Christian Marinotti Edizioni, Milano 2007 p. 22, edizione originale *La Cimbra y el arco,* Barcellona 2005.

Building Research & Information of May 2008, dedicated to this theme, gathering the contributions emerging in relation to a Symposium held in 2007 on *Theory of the Built Environment* at the University of Salford (UK). In his view, a project theory becomes necessary as a scientific instrument of mediation between objectives of knowledge and results, as an instrument of evaluation and validation, as an instrument for exceeding a theory in the light of the anomalies and deviations found at the procedural level[5].

Thus know-how, whether addressed to the architectural project or to the built environment, postulates a theory as the scientific basis of transmissible knowledge. In this way it has to allow for training for research in architecture and in architectural technologies. But it is precisely in the ambit of the disciplines of architectural technology, insofar as they take over the concept of a built environment, that a theory assumes the role of engine of scientific innovation, moving from conceptual systematisations (frameworks, concepts) and from observation of the system of artefacts, processes and the environment, to exceed itself and innovate.

Some theories of the built environment

I evoke hereafter some of the theories relative to the built environment, which in a more or less explicit way are assumed as references in doctoral researches and which I have had occasion to observe directly. Without attempting to be exhaustive, I use these references to back up the thesis proposed and to emphasise that it is not a question of thinking of a unified theory, but of various theories on which to base research.

From the work carried out in the 1960s and 1970s for formulating a theory based on the concept of system and of requirements for use, we should remember among others in particular the contributions at international level of Gérard Blachère (1965) in France and of Pietro Natale Maggi in Italy and the Guides drawn up by the Ministry of Housing and Local Government in the UK: *House planning – A guide to user needs, Design Bulletin* 14, 1968. From these original formulations the technological disciplines of architecture in fact started off in Italy.

[5] . Lauri Koskela, University of Salford UK, "Is a theory of the built environment needed?", *Building Research and Information*, may 2008.

This theory evolved and was innovated until today it has taken on at international level the name of performance-based theory, more specifically with specific reference to building constructions – *Performance Based-Building*[6] – and more in general *user-centred theory of the built environment,* with the contribution of economic, humanistic and social disciplines and, among the latter, above all recently, of environmental psychology[7].

The relationship between social behaviours and the built environment, at urban level the object of urban sociology studies, has assumed important valences also in study of the configurations of architectural spaces. In the mid 1980s, at the Barlet School of University College London, a theory was formulated supporting design based on analysis of the configuration of space in order to highlight social behaviours. This is the *Space Syntax* theory which has perfected descriptive and verifiable instruments of designing spatial configurations and the evolution of which is particularly oriented to the transcription of contributions by sociology[8].

The process of design in architecture was the object of theories in the 1960s, motivated by the determination to get beyond a traditional approach to design practice, inadequate to deal with complexity. In "*A decade for design research in the Netherlands"* (2005), the reader is reminded that "In the proceedings of 1995, Robert Oxman noted two major orientations of design research: the design cognition orientation which leaned very much on protocol analysis, and the computational models orientation which leaned very much on information processing theory" (Oxman 1995). In presenting the state of the art in 2005 the following statement is made: "It is fair to say that much of the rigorous, methodological and scientific content of design research has come into being just because of the concepts and framework introduced by RPS (Rational Problem Solving) and computation", indicating as future prospects of theoretical research: the transfer from areas such as "decision-making under uncertainty", (see for example Baron 2000) and, for theories on the collaborative process, the concepts of *agency* and *multi-agent systems* (Weiss 2001) for the definition of formal modelling instruments, and

[6] R. Becker, G. Foliente (editors), *PBB International State of the Art*, final Report EUR 21989, ISBN 90 6363-049-2 october 2005.

[7] Wolfgang FE Preiser, Jacqueline C. Vischer, editor, *Assessing Building Performance*, Elsevier 1999.

[8] Bill Hillier *The Social Logic of Space,* Cambridge University Press, 1984.

in general the *social sciences* which study interpersonal dynamics in design (e.g. Lloyd and Busby 2001; 2003)[9].

In the studies relative to the building sector, starting off from the 1950s different theories were worked out on industrial production (see in Italy the studies of Giuseppe Ciribini – 1965 – and the others quoted in the note[10]), highlighting the specificities of the sector compared to other sectors of economic production: project-based production, itinerant business, temporary organisation, in fact shared also with other ambits of production. The different theories on the relationship between industry and the building firm have led to the working out, not only of strategies but also of concepts relative to process innovation in the building sector[11]. The theory of quality applied to constructions as from the 1980s and 1990s has made a contribution to the theories of organisation of the building process, in particular as regards the building of an integrated and progressive model (spiral) of the industry-project-building-management supply chain, with a view to continuous improvement[12].

The question of sustainability, raised first of all by the question of energy and of environmental safeguard, and thereafter extending to include principles of social and economic sustainability, today lays down new scientific paradigms in all disciplines. In the ambit of architectural technologies, this consolidates with renewed force and new perspectives the systemic approach, extending the confines of the observed system, both in spatial terms (the global environment – regional systems of 'cradle to grave' processes), and in temporal terms (life cycle). In more recent evolutions the theory of sustainability has to deal with the relationship between the *mass flow accounting* method applied to the balance sheet of *input/output* in *life cycle assessment* and performance and value analysis theories applied to the different scales of the building process and of the service life of constructions[13].

[9] Henri Achten, Kees Dorst, Pieter Jan Stappers, Bauke de Vries, *A Decade of Design Research in the Netherlands*, Proceedings 2005.

[10] Giuseppe Ciribini, *Il processo dell'industrializzazione edilizia*, Dedalo, Bari 1965, P.N. Maggi, G. Turchini, E. Zambelli, *Il processo edilizio industrializzato*, F. Angeli, Milano 1971, AA.VV., *Prospettive di industrializzazione edilizia*, F. Angeli, Milano 1976.

[11] A. Andreucci, R. Del Nord, P. Felli, E. Zambelli, *Verso l'industrializzazione aperta*, Milano ITEC 1979; G. Giallocosta, *Imprese, mercato, innovazione*, Alinea Firenze 1996.

[12] M.C. Torricelli, S. Mecca, *Qualità e gestione del progetto nella costruzione*, Alinea, Firenze 1996

[13] S. Moffat, N. Kohler, "Conceptualizing the built environment as a social ecological system" in *Building Research and Information*, may 2008

Theoretical originality of doctoral research

While the thesis sustained here of the innovative function of theories could be agreed with, doctoral training should aim at developing a capacity of carrying forward research at international level, capable of producing, transferring and utilising knowledge, with sensitivity, creativity and flexibility. In this sense doctoral research is an important opportunity for doctoral candidates and tutors to integrate aspects of basic and applied research, with a view to scientific and industrial innovations.

In the ambit of the CIB, the Task Groups and TG53 Working Commissions – Postgraduate Research Training in Building and Construction has proposed to develop projects aimed at backing up the requisites of Skills Training of the post-graduate researcher community undergoing training, aimed at promoting:[14]

- the capacity of recognising and validating problems;
- an original, independent and critical thought and the capacity of developing theoretical concepts;
- a knowledge of recent advances in the sector;
- understanding of the most important research methodologies, of techniques and their appropriate application;
- the capacity of critically appraising others' results and theses;
- a capacity of summarising, documenting, reporting and reflecting on evolutions.

Capacity of transfer and employment prospects

A recent article appearing in the on-line Magazine of the Italian Society of Statistics SIS[15] discusses the prospects of an academic career for doctors in research in Italy in relation also to the recent legislative interventions on public competitions. This starts from noting that in the period 1998-2007 the number of doctors in research has more than tripled, while the employment of this resource in the university ambit is very low. "The training of doctors in research is targeted at

[14] Task Groups and Working Commissions TG53 – *Postgraduate Research Training in Building and Construction Progress Report* by Dilanthi Amaratunga Kanuary 2009.

[15] <http://www.sis-statistica.it/magazine/spip.php?article140/>.

the acquisition of competences intended for utilisation in the sector of research which in the majority of cases the doctoral candidates expect or hope to carry out in the university environment. Unfortunately these expectations, based on the information at present available, would not seem to be borne out." Between 1998 and 2007 the number of teachers (Full professors, Associated professors, and Researchers) in the Italian universities rose by 24.1%, that of researchers by 23.4%, while the researchers called in the same period numbered 16,381, the doctors coming out in the same period were 53,795 (Source: Eighth Report on the State of the University System – CNVSU (2007). The statistics do not allow us to say if those researchers were all doctors in research (that is, if about 30% of the doctors in research coming out in those years have been taken on as permanent staff), while other data indicate that the percentage of former grant holders present in the ranks of university researchers at July 2006 was 81.4% and at July 2007 78.2% (Source: Ministry of Education University and Research – MIUR), confirming that the road of the grant almost obligatorily leads to inclusion in the permanent staff.

Data are not available on-line that enable us to carry out the same analysis for the ICAR 12 sector of scientific disciplines, it may only be noted that doctors with doctorates in the ICAR 12 area numbered 354 between 1998 and 2006 (finding on the MIUR data bank, save any omission or inclusion of doctors from interdisciplinary doctorates). How many of these doctors are at present employed in the academic ranks, or are grant holders and researchers on a time contract, it should be possible to discover from an analysis of the reports of the University Evaluation Units, but as observed from various quarters these models of recording are rather inadequate to ensure reliable statistical analyses.

For the recording of career outlets for the doctoral candidates in the ICAR 12 area a work had been started up with the Giovanni Neri Serneri observatory and thereafter with the data bank on the OSDOTTA site, but lack of resources for carrying through the project makes any recording of the data from such sources impossible.

So that we can only make qualitative evaluations on the basis of direct experience and report that in the last few years, together with a powerful reduction in the possibilities of university career prospects there has been an enlargement, albeit inadequate compared to supply, in the demand for a professional competence of advanced level in activities of an innovative and complex nature in various ambits: evaluation, programming, design, building production, etc.

Demand is mainly concentrated on themes representing the present priorities for the sector and for which, since no consolidated rules and instruments exist, there is need of critical capacity and original thought: materials and systems innovation, sustainability and energy efficiency, design of complex systems, process management, management of the heritage, etc. Where such demand arises it is still difficult to say, but undoubtedly it arises in an occasional and sporadic way within: advanced professional structures, entrepreneurial structures, industry, local and central bodies for the management of the territory and of the building heritage. These are places that, even if they do not allow space for basic researches, however require professional qualifications capable of the transfer and development of ideas, methods and solutions.

To conclude, accordingly, the present picture of demand, while not comforting on the possibility of fully ascertaining the resource represented by doctors in the research environment, all the same confirms the need to utilise the years of doctoral training to lay the bases of a skill in creative and innovative work, founded on the capacity of original, independent and critical thought, generally developed by theoretical and conceptual work.

Gabriella Caterina[1]

Inter-university research doctorates

In the last decade, the principle that knowledge is the key to sustainable development in contemporary society, declared in Lisbon by the European council in March 2000, has informed the actions undertaken by the European Union as regards training, employment and social cohesion. In order to promote the move from an economy based on the use of natural and human resources to a knowledge-based economy, actions to support and promote multi-sector and multidisciplinary training, with mobility as the main aid for the creation of a cultured and educated society. Training is essential to a person's development (so that he can fulfil his own potential and have a good quality of life), and to society (promoting democracy, reducing inequalities and promoting the value of cultural diversity) and to the economy (ensuring that the training of the workforce is sufficiently in line with economic and technological development). Based on the strategy of European competitiveness, announced in Barcelona in 2002, the University is the main reference point for the development of excellence. This can be achieved by structuring knowledge networks that combine the global and local, national and international dimensions to help accelerate the processes of research and innovation.

The challenge of mobility in the research doctorate process

The establishment of a favourable environment for scientific research is one of the policies followed by Italian universities, starting with

[1] Università degli Studi di Napoli "Federico II".

the Bologna process to help build a European Higher Education area. In particular the research doctorate in the third cycle of the Bologna process aims to provide advanced training and develop the necessary skills for those who wish to start a professional research activity, whether in the academic sphere or elsewhere. The progress of knowledge through an original, complex research project, based on the interaction between excellences, is the key to doctoral training. Promotion of the mobility of the professors and doctoral candidates between universities is one of the added values of the European Higher Education Area.

By implementing mechanisms that encourage transferability, the Inter-university doctorate supports the objective of training a researcher who is aware of the intrinsic complexity of the doctoral discipline and able to find his way through forms of knowledge coming from different spheres of application, combining these with cultural processes completed in different educational institutions.

The promotion of common scientific, cultural and social experiences is one of the main aims of the inter-university doctorate, to multiply the specific training effects of each of the universities involved in the common process. The organisation of the inter-university doctorate has a scientific basis in the creation of conditions of cultural interconnection among the academic staff, so as to overcome the universities' self-containment. In order to strengthen the link between them, it would be desirable to use a network type of interaction model, in which the knowledge-building process is accomplished through a networking system set up by each graduate student.

The inter-university research doctorate experience in building and environmental restoration

The Research Doctorate in building and environmental restoration was established in Genoa in 1988 as a consortium of the Universities of Genoa, Milan, Turin, Naples and Palermo and in 2003 transferred its administrative headquarters to the University of Naples' Department for architectural configuration and implementation (DICATA), re-proposing the inter-university consortium model and involving the Federico II University in Naples, Palermo, Genoa and also the University of Bucharest.

The purpose of the doctorate is to train researchers who have international skills, working in the restoration sector, experts in requalification, re-use and maintenance of the building, the urban and environmental

heritage. These researchers will be aware of the intrinsic complexity of the disciplinary sphere of the doctorate in relation to the following curricula: *Analysis and action plan for existing buildings* concentrating on traditional and modern construction techniques; structural conceptions, morphological, distributive and functional characteristics of the architectural body of ancient or recent construction; the state of degradation and disorder; the role of the new materials and innovative technologies; *the "management process" of building, urban and environmental restoration in relation to the characteristics of the action phase on existing buildings,* the expertise and the persons involved in the management of technical, economic and regulatory resources. The curricula also include *maintenance of the building heritage, urban areas and the local territory*, as regards methods and procedures for planning, design and management of the maintenance activities, and through the definition of a model for the understanding of the (building, urban, territorial) system described, and through forecasting and interpreting the phenomena of building failures, and evaluation – in terms of efficacy and efficiency – of the maintenance strategies for the conservation and improvement of the built heritage. In relation to the sphere of maintenance we point out that the DICATA (associated with the University Quality Centre) in 2006 obtained UNI EN ISO 9001-2000 quality certification for the research activity in "Procedures and operative tools for building maintenance" from Italcert, renewed in 2008.

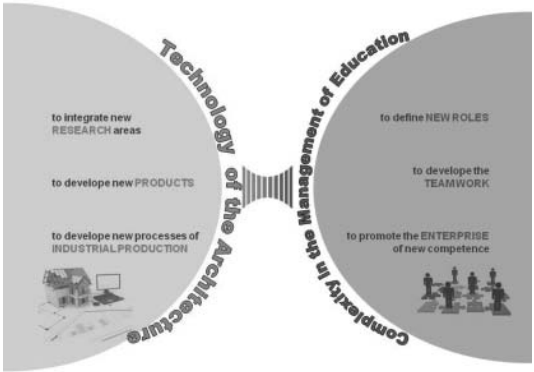
From the point of view of the specific contents of the doctorate, the teaching and research commitment is oriented towards encouraging the advance of scientific thought in relation to intervention on the built environment. The doctoral candidates' theses approach the project of existing buildings on various scales (building, urban and human landscape), investigating potential and strategies for the restoration and reuse of buildings.

The continuity between town and building is the foundation for the training process, identifying in the relations between the distinctiveness of architecture and the urban environment one of the qualifying features of the doctorate in building and environmental restoration. The chosen approach is to conceive the research work as an opportunity to translate the knowledge of the existing built environment into methods for handling the intervention (regulatory and procedural tools, operative techniques, etc.) so as to guarantee quality outcomes for actions in favour of the existing building heritage. The result is that the training experience, being calibrated to the research projects that develop the system of relations among specific types of expertise,

adequately matches the demand for highly qualified professionals who are able to develop research with the aim of guaranteeing that quality objectives are reached in the planning, design and completion phases and in the management phase of the action.

In the light of this situation, in defining the relations between the research activity and the training process, the doctorate is organised in such a way as to give greater and greater importance to research. The course is structured around a possibility of interaction, which crosscuts the Italian Architecture faculties. The academic staff are convinced that the doctoral research experience is the first, important step towards the definition of a scientific "personality", which processes logical instruments, references and methods to guide the positioning of the doctoral candidates' experience in the scientific community and in the professional world. Therefore a significant role is played by the scientific production of the doctoral candidates, who are encouraged during the three year university course to publish in specialized magazines, to participate in conferences with their own contributions and to attend courses in Italian and foreign research centres. They are also encouraged to experience researching abroad and to establish a network of relationships with personalities of the international academic world. On the administrative side, doctoral research is part of the School of Doctoral Research of the faculty of Architecture of the Federico II University in Naples. Being part of the School has involved adopting the system of credits used by all the doctoral courses in the School, evaluating the entire training process, not only its product. This is why the type of research varies from assisted activities (year I and year II) to individual research (year II and year III). During the first year, the training focuses particularly on preparatory courses for the thesis, consistent with the objectives of the doctoral student and the objectives of the course itself. During the second year the balance between training and research shifts towards research – with fewer credits and hours of training, which is instead directed towards specific themes of the discipline of renovation. Research becomes decisive both in the development of the candidate's thesis and in establishing relations for future research in Italy and abroad, which are highly encouraged. The third year is decidedly oriented towards the completion of the research process, enriched by seminars and by research experience in Italy and abroad.

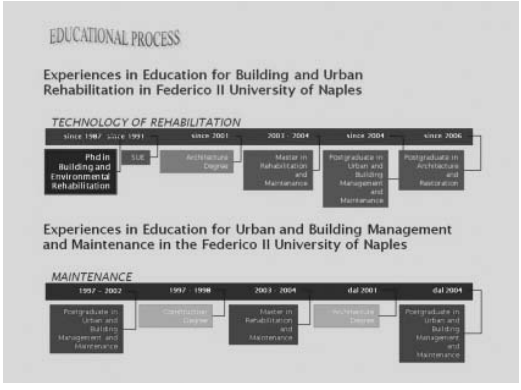
As already stated, among the objectives of the educational process, it is particularly important for the doctoral candidate to achieve scientific autonomy and to prepare his own research curriculum.



Conclusions

The "Declaration on Education & Research for Sustainable and Responsible Development" – May 2009 – underlines the key role that must be played by Universities in contributing to create and disseminate a sustainable and responsible culture of development, both globally and locally. Training and research will play a key role in supporting the decision-making processes using the appropriate integrated and interdisciplinary approaches, in order to favour the definition of new socio-economic development methods with a more efficient use of resources. The transition of Europe towards sustainable development is directly connected to the capacity to link scientific and technological efforts with economic and social progress by increasing the number of exchanges. This is where the contribution of the inter-university doctorates comes in. In third level education they contribute to enhancing solidarity among different cultures, thanks to the development of entrepreneurship and to making and expanding local development. The objective of tracing an original and innovative path is gaining the value of an informed and significant choice both in teaching and in training the new generations in the field of research. There are so many fields of research nowadays that a new discussion has been found necessary within the SSDs. This discussion, from the interests of one specific field has since spawned a wider vision of research and experimentation. The Architectural Technology discipline, in spite of the changes caused by the outside world, has maintained a clear will to pursue the path followed by the "first generation" of professors of Technology. The link between research, product and industrial production has

brought out the problems of the building process, from maintenance to management, proposing a learning scheme that must always be kept up to date with social and economic changes, involving crucially important impact evaluation studies. The complexity of the training that we nowadays have to face imposes the need to look ahead in order to build a future where Universities will produce protagonists as well as skills. The disciplines of Architectural Technology that, for its nature and culture, claims the paternity of a research linked to its operational implications, offers Architecture Schools an interdisciplinary dimension in which creativity, culture and competence create new training procedures that encourage team work and self-management, by going beyond single abilities and by tackling research and experimentation with a flexible and functional approach.



Virginia Gangemi[1]

Doctorate teaching experience in Milan and Naples

My personal experience on the structure of doctorate research, begins with the 1st cycle of the doctorate and with the activation of a doctorate in Architectural Technology in 1983 at the Milan Polytechnic, coordinated by Giuseppe Ciribini.

Infact, in those years, with the foundation of the Research Doctorate, a new experiment invested the Italian University and with the beginning of the first cycle of the research Doctrate it prospected new horizons for qualified formation of youth in the research sector. For the first time such a formative activity was given to professors of different Italian Universities; from the numerous and varied possibilities to work in equip, to the critical revision of the scientific research methods of its own specific disciplinary sector, which offered a determinant push to this new institution, with the prospective of being able to form a new qualified generation of young researchers.

To have wanted the University of Naples, Federico II among the Doctorate union, together with the Polytechnics in Milan and Turin and the University of Genoa, was the precise choice of Giuseppe Ciribini, to whom we are grateful, for taking part in an experience which was, both for us the professors of the doctorate and for the students, who had the opportunity to take part in this particular formation, the opportunity of cultural growth and a scientific maturity of particular intensity.

For the first time in Italy, young graduates were given the possibility to continue for three years in the activity of research, under the guide

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of highly qualified lectures such as Marco Zanuso, Roberto Mango and the same Giuseppe Ciribini, to cite just a few, together with us, younger lecturers, who in comparison to the renown masters, received notable stimuli and opportunity for cultural growth.

This experience, although tiring on a logistic plain and binding because of the frequency of the meetings, represented without doubt, a privileged place for the debate in merit to the technical research in Architecture and the widening of disciplinary boundaries through a confrontation with the most advanced lines of the contemporary philosophic and scientific thought, proposing a substantial revision and reformation in the research of the specific sector. The introduction of a vision, culturally open and rich in questions, techniques and technology, opposed to the dogmatism and schematics of an uncritical and determined technologic formation, posed, to the Doctorate Union, the bases for redefining the thematic of research and a revision of the methods of scientific research, already consolidated in our sector.

In the initial stages of the Doctorate activity, the individualisation of the topic to assign to do the thesis of the first doctorate from Naples, architect Umberto Caturano, today an associate professor of Technology of Architecture, quickly revealed itself to be a complex operation, which involved me in quality of tutor, in as we had to conjugate interests, experience and cultural potentiality of the doctorate with the expectations of the board of teachers, who rightly requested originality and particular scientific rigor in the development of the work. The preparation shown previously by Umberto Caturano for research in the informatics sector and the coincidence in the possibility to develop a study with the collaboration of two lecturers of particular scientific value, Stefano Levialdi and Virginio Cantoni, from the Informatics Department of the Faculty of Engineering at the University of Pavia, advised us to orient ourselves towards the study of the potentiality that could be offered, to the research of Technology of Architecture, Iconic Informatics, which at that time represented an instrument of new investigation until then little explored. The centre of the thesis for the doctorate, was, in a general sense, outlined inside the relations between the technological culture of the project and informatics technologies, whilst the more specific objective could be found in the research of classification forms to define a glossary of *Visual Information* connected to the materials and their elementary aggregation, such as for example the plot and contents.

The thesis, entitled *New cognitive instruments of architectonic images. The contribution of iconic informatics*, was finished in 1986, but had an ideal line

of continuity through a second thesis on the theme *A reading of the visible alterations of construction materials* developed in the 2nd cycle of the Doctorate, again with my tutorship, by Sergio Rinaldi who also came from the Naples University. The study dealt with the problem of morphological reading of the surface in architecture to gather and classify, by using objective instruments, signs of degradation and therefore the preceding experience of research conducted by Umberto Caturano showed to be particularly precious and useful.

I followed other doctorate thesis, equally interesting, during my stay at the Union of lecturers an the Polytechnic of Milan, all the same the didactic experiences of the 1st and 2nd cycle of the Doctorate remain unforgettable, in that they particularly involved me, in commitment and sense of responsibility, as the teaching of post degree courses was a novelty and required establishing relations between student and teacher which were absolutely innovative and experimental.

If I compare the experience during the years of the Doctorate at the Polytechnic of Milan, so enthusiastic and committing, with today's actual activities of Doctorate, I must concede that I have been discouraged in these last years, with frequent and often contradictory ministerial indications, the activation of intersession Doctorates, which have reduced the possibility of confrontation, of exchange and interesting contacts between lecturers at a national level, negatively influencing upon the growth and evolution of scientific methods.

It was just after the ministerial indication, which supported the in-seat Doctorate, in respect to intersession Consortium that some lecturers of the University of Naples Federico II, among which myself, decided to activate, for the academic year 1991-1992 in Naples, a research Doctorate in the Technology of Architecture, in correspondence with the beginning of the 7th cycle of the Doctorate. The request of major frequency, of students coming from Naples, to the activities promoted by the Milanese Doctorate, and the hardships of travelling which was not helped by any government grants, had an influence in our decision to separate ourselves, which all the same I have always thought to be an inevitable impoverishment of cultural stimuli.

For twelve years I acted as Co-ordinator of the Doctorate, having its seat at the Department of Architectural Configuration and Accomplishment, which, in the first phase, until finishing the 16th cycle, had the title of "Technology of Architecture" and changed its name from the 17th to the 19th cycle,. With the incorporation of the Doctorate in Relief and Representation of Architecture, imposed by Federico II

University, due to the lack of economic resources, the Doctorate was divided into two courses, the first being Technology and the second Representation, assuming the ambiguous and vague title of "Technology and Representation of Architecture and Environment". A forced union which did not work out well, like other aggregations favoured by our university. Aggregations which did not permit real disciplinary integrations due to the difference of the disciplines which used entirely different methods of scientific research, and which we all though as useless bureaucratic weights.

Finally, at the beginning of the 20th cycle of the Doctorate, we received the long awaited break from the Representation Doctorate, an operation which however required a price to pay: the reduction of some Doctorate scholarships. It is during this phase that the seat of the Doctorate was transferred to the Department of urban and town-planning and the role of Doctorate Coordinator was given to Prof. Augusto Vitale, in respect of a natural alternative principle.

In this period, Federico II University of Naples established the Doctorate Schools, an aggregation of Doctorates with generic disciplinary similarities, with the task of both restarting internally the scholarships, given to the School in an always more reduced form, and to organise courses on transversal themes, general in character which could be followed by all Doctorates who were part of the same Doctorate school.

The introduction, also in the third level of the university formation, of credits, to guarantee a constant participation both of the staff and the doctorates to the specific programmed activities, still has not given particular evident effects on the cultural growth of such structures but it has surely produced a remarkable effect for the bureaucratic administration of such structures.

In conclusion to these brief notes, I like to remember as cited the first two thesis of the Doctorate, which I participated in, as a tutor, and also the last two.

The first developed by architect Andrea Brecci, in the 19th cycle, is entitled: *Valuation of landscape impact: innovative methods and procedures*, and based on the specific field of environmental quality control of the disciplinary scientific sector in Technology of Architecture. The work done by Andrea Brecci is concentrated upon the research of an innovative method and scientific procedures which permit the analysis and valuation of landscape impact, determined both by the construction of new buildings and the restructure of degraded buildings and urban areas in particular prominent environmental contexts.

During the period of writing the thesis, the DPCM 12.12.2005 decree was issued, which instituted the landscape relation, to cover an existing legislative aperture regarding the analysis and appraisal of the impact on landscape of constructing buildings in protected areas.

The research carried out tended to single out a control system which, although proposed reaching the same conclusions of landscape relations, reduced the character of risks, which distinguish many analysis and opinions of the commissions involved in releasing permits of construction in environmentally protected areas.

Another interesting aspect of the proposed method is shown in its potential versatility of application, as it can also be used by planners in the planning stages and for inspection of urban instruments through valuing the impact which the proposed plan brings about.

The last Doctorate thesis, of the XXI cycle, developed under my guidance, was concluded in the 2008-2009 academic year, and speaks about the possibility of residential one-family architecture, in order to verify the effective environmental quality offered by such construction, selected as study cases both in Italy and abroad and indicating planning guidelines in this specific sector.

This last tutoring experience coincides with the conclusion of my career as a University lecturer and I am sure that the hopes that I hold as regard as this study, done with great passion by Architect Sara De Micco, who has lived abroad for long periods both to obtain direct information and to follow experimental planning, will be fully satisfactory, with original and rigorous research both regarding the investigation of the fonts and the conclusive indications of the project.

Maria Antonietta Esposito[1]

The doctorate in the Bologna Process

The Bologna accord, usually referenced as the Bologna Process, was signed in 1999 by the Ministers of Education from 29 European countries putting into practice the intent of "harmonising the architecture of the European Higher Education system" expressed in the Sorbonne declaration (Paris 1998).

The efforts towards the improvement of Higher Education results start from this fact underlined by the European Commission: Europe has around 4,000 higher education institutions, with over 17 million students and 1.5 million staff. Some European universities are amongst the best in the world, but the overall potential is not used to the full. Curricula are not always up-to-date, not enough young people go to university after finishing school and not enough adults have ever attended university. European universities often lack the management tools and funding to match their ambitions[2].

The Bologna accord attempts to give a contribution to European education harmonisation in the broader framework of the Lisbon Strategy for Growth and Jobs. The European Commission, also having a role in this process, in its modernisation agenda, has pointed to three broad areas of possible reform in higher education:

Curricular reform: The three cycle system (bachelor-master-doctorate), competence- based learning, flexible learning paths, recognition, mobility.

[1] Università degli Studi di Firenze.

[2] <http://ec.europa.eu/education/lifelong-learning-policy/doc62_en.htm>.

Governance reform: University autonomy, strategic partnerships, including enterprises, quality assurance.

Funding reform: Diversified sources of university income better linked to performance, promoting equity, access and efficiency, including the possible role of tuition fees, grants and loans.

The Bologna process aims to create the Higher European Education Area (HEEA) in the year 2010 to harmonise standards and quality assurance standards, making them more comparable and compatible throughout the EU countries.

The European harmonisation vision is based on the Dublin Descriptors[3] developed by the Joint Quality Initiative. These are proposed for adoption as the cycle descriptors for the framework for qualifications of the European Higher Education Area. These descriptors offer generic statements of typical expectations of achievements and abilities associated with awards that represent the end of each Bologna cycle. Responsibility for the maintenance and development of the framework rests with the Bologna Follow-up Group and any successive executive structures established by the ministers for the furtherance of the EHEA. The framework also includes guidelines for the range of ECTS typically associated with the completion of each cycle:

- Short cycle (within or linked to the first cycle) qualifications – approximately 120 ECTS credits, that in Italy corresponds with the Laurea Triennale (three-year degree course);
- First cycle qualifications – 180-240 ECTS credits, that in Italy corresponds with the Laurea Triennale within or linked to the second cycle (3+2);
- Second cycle qualifications – 90-120 ECTS credits – the minimum requirement should amount to 60 ECTS credits at second cycle level which in Italy corresponds to Laurea Magistrale (two-year post-graduate course)

In Italy the cycle which qualifies skills for protected professions (medical doctor, architect, lawyer that are registered professions enabled by State examination, the same in France and Spain as well) have maintained also the single cycle degree organisation that also corresponds

[3] <http://www.tuning.unideusto.org/tuningeu/index.php?option=com_weblinks&Itemid=4&catid=27>.

for architects to the EC Directive 2005/36/EC (in force in Italy since the year 2007, see art.52 of DLgs 206/2007 that has confirmed quite literally the requirements for architects' skills as listed in the 11 points of the former directive in 1985)

- Third cycle qualification, corresponding to Master and Doctorate do not necessarily have credits associated with them.

During the development and implementation of the Bologna process, each cycle has been discussed and the re-design and planning of education curricula at national level has been applied by all member countries. Lastly the third cycle qualification has been examined but maintaining autonomous organization of the existent different national approaches. The typical approaches in doctorate qualification in Europe are:

- structured Doctoral courses;
- Tutoring.

Each type of doctorate may also be national or foreign partnership driven such as:

- International co-tutoring: this allows the possibility to have a bilateral agreement, previously approved by Teaching body, for specific research. The doctor qualification, signed by the Rectors of both universities, is achieved through a discussion in the two countries' languages attended by both countries' members[4].
- International doctorates are based on a permanent agreement among institutions belonging to different countries. Both countries' members form the Teaching body. The Rector of the University that hosts the international doctorate signs the doctor qualification.

In all types of doctorate it is possible to accept individual EU as well as international students who applies.

[4] See the University of Florence rules Art. 21 – Modalità di ammissione e rilascio del titolo; Art. 22 Accordi internazionali di co-tutela di tesi di dottorato.

The new, recently introduced third cycle configuration in France, formerly characterised as in Italy by three- year courses, with the start up of interdisciplinary courses in first year courses, with the partial abandonment of mandatory courses of a specialist character during the first year, and by the improvement of seminar activities and research groups can be seen as a preparatory phase for easier international activity implementation.

The international doctorate courses are foreseen in Italy by the internationalisation policy of the Ministry for the University and Research (art.7 of min. decree21 of June 2000 and following amendments on December 20-1999, January 26 -2000, and July 13-2000 and 27-2001).

In Italy the doctorate is organised in cycles of structured courses yearly approved by the Minister of Education on the basis of each university proposal. In 2009 the xxiv cycle of doctoralcourses set up by the Italian universities in the various disciplines have been approved: the Courses offered are published every year in the Higher Education web data base in the Italian Ministry of the University and Research website[5].

The doctoral courses in Building Technologies corresponding to the Italian Sectoral Scientific Classification – SSD n. ICAR/12, were created in 1984 (see Gangemi V.) and were also networked in 2004 (see Torricelli M.C.) looking forward to international competitive challenge.

Goals and steps

The Bologna accord formally follows the application of the Lisbon Convention (signed in 1997, in force since 1st Feb.1999) that stipulates degrees and periods of study must be recognised without substantial differences and in a harmonised way. The institution responsible for recognition can validate the degree. As a consequence of the accord the students and graduates are protected by fair procedures under the Convention. The goals of the accord are related to issues such as the social dimension of higher research and research, public responsibility and governance for higher education and research in the globalised and increasingly complex societies with the most demanding qualification requirements.

[5] <http://offf.miur.it>.

The process involves steps to achieve political goals such as:

- Easier European mobility for the purpose of study and employment
- Adoption of aspects of the American system of education to create a greater convergence
- Attractiveness of study/work in Europe from non-European countries
- Provision of a broad, high quality and advanced knowledge base (ERA – European research Area), ensuring the further development of Europe.

The Bologna process has been developed in several steps: every second year the Ministers meet to measure progress and set priorities for action. After Bologna (1999), they met in Prague (2001), Berlin (2003) and Bergen (2005). They met again in London (17/18 May 2007) and reconvened in Leuven/Louvain-La-Neuve (April 2009). At the London meeting of 17/18 May, Ministers adopted a strategy on how to reach out to other continents. They also gave their approval for the creation of a Register of European Quality Assurance Agencies[6].

The Bergen meeting highlighted the problem of quality management in Higher Education: the Standards and Guidelines for Quality Assurance in the EHEA adopted in Bergen (ESG) have been a powerful driver of change in relation to quality assurance. All countries have started to implement them and some have made substantial progress. In Italy most of the degree courses have been certified on the basis of CRUI (Conferenza dei Rettori delle Università Italiane) quality management system model. The third party audit process for quality certification in particular was much better developed than before, since the Campus One pilot program in 2000. The extent of student involvement at all levels has increased since 2005, although improvement is still necessary to better match available resources with planning and offering courses. The Agency for quality evaluation of Universities and Research (ANVUR) has also been planned in Italy . The first European Quality Assurance Forum, jointly organised by EUA, ENQA, EURASHE and ESIB (the E4 Group) in 2006 pro-

[6] See for more information the Bologna Secretariat Web (<http://www.ond.vlaanderen.be/hogeronderwijs/>, Bologna).

vided an opportunity to discuss European developments in quality assurance.

With the Berlin communiqué in the year 2003 additional actions were added: "…Ministers consider it necessary to go beyond the present focus on two main cycles of higher education to include a doctoral level as the third cycle in the Bologna process." It should correspond worldwide to UNESCO's ISCED Level 6 that refers to tertiary education leading to an advanced research qualification.

After the London meeting in the year 2006, the closer alignment of the EHEA with the European Research Area (ERA) was pointed out as an important objective. The London meeting recognised the value of developing and maintaining a wide variety of doctoral programmes linked to the overarching qualifications framework for the EHEA, whilst avoiding overregulation. At the same time the participants recognised that improving conditions in the third cycle and improving the status, career prospects and of and funding for early stage researchers are essential preconditions for meeting Europe's objectives of strengthening research capacity and improving the quality and competitiveness of European higher education.

Mobility

Mobility of doctoral students is underlined as an instrument provided for by the process of harmonisation. In the national reports for 2009, action taken at the national level to promote the mobility of students and staff, including measures for future evaluation will be reported on. Mobility targets will focus on the main national challenges identified. This includes encouraging a significant increase in the number of joint programmes and the creation of flexible curricula, as well as urging our institutions to take greater responsibility for staff and student mobility, more equitably balanced between countries across the EHEA. Thus the role of national/European doctoral networking seems to be crucial for the future.

Researcher skills

Researchers are personnel trained for research. The word research, as used in Europe, covers a wide variety of activities, with the context often related to a field of study; the term is used here to represent a careful study or investigation based on a systematic understanding and

critical awareness of knowledge. The word is used in an inclusive way to accommodate the range of activities that support original and innovative work in the whole range of academic, professional and technological fields, including the humanities, and traditional, performing, and other creative arts. It is not used in any limited or restricted sense, or relating solely to a traditional 'scientific method'[7].

Researcher skills should follow the Dublin descriptors qualifications signifying that completion of the third cycle is awarded to students who:

- have demonstrated a systematic understanding of a field of study and mastery of the skills and methods of research associated with that field;
- have demonstrated the ability to conceive, design, implement and adapt a substantial process of research with scholarly integrity;
- have made a contribution through original research that extends the frontier of knowledge by developing a substantial body of work, some of which merits nationally or internationally refereed publication;
- are capable of critical analysis, evaluation and synthesis of new and complex ideas;
- can communicate with their peers, the larger scholarly community and with society in general about their areas of expertise;
- can be expected to be able to promote, within academic and professional contexts, technological, social or cultural advancement in a knowledge- based society.

The students who have completed the one of the Doctoral Courses within the OSDOTTA Network should also possess the Dublin skills. Such requisites are the basis to be able to compete at the international level as well.

Criticisms

Nevertheless the process seems to be broadly discussed with the aim of being accepted at the national level, but it has been also strongly

[7] Ministry of Science, Technology and Innovation, Ministry of Science, Technology (DK), pag.68.

criticised because it would allow privatisation of degrees. Looking at the economic context created with the GATS (General Agreement on Trade in Services), the treaty was created by the WTO (World Trade Organisation) to extend the multilateral trading system to the service sector, in the same way the General Agreement on Tariffs and Trade (GATT) provides such a system for merchandise trade.

Thus also the Education services which some countries seek to'export' as profitable industries, are involved in such a policy. The GATE: Global Alliance for Transnational Education, changed character dramatically in 1998: going online, and becoming for-profit only.

From the academic side Dr Chris Lorenz of the Free University of Amsterdam has underlined "The basic idea behind all EU educational plans is economic: the basic idea is the enlargement of scale of the European systems of higher education, ... in order to enhance its 'competitiveness' by cutting down costs. Therefore a Europe-wide standardization of the 'values' produced in each of the national higher educational systems is called for." Just as the World Trade Organization and GATS propose educational reforms that would effectively erode all effective forms of democratic political control over higher education, "it is obvious that the economic view on higher education recently developed and formulated by the EU Declarations is similar to and compatible with the view developed by the WTO and by GATS."

The opinion of prof. C. Lorenz in relation to implementation in different countries looks to anticipate problems that we've already recognised in Italy: the target of increasing the number of graduated students as well as adapting higher education curricula to market variables have produced more than 5000 degree courses instead of the former 1800. It happened in an unfavourable economic scenario and the process needs to be evaluated and quality to be assessed. The need for more resources for education and research to offer such a possibility in order to dynamically modify higher education levels does not match the availability of financial resources that, on the contrary have been cut.

Redesign

The result of the Bologna process was the Bachelor/Master structural reforms in many countries e.g. Germany, Italy, Netherlands; not where the two-cycle structure already existed e.g. UK, France., nor where two-level structures already existed e.g. Central/Eastern Europe.

The Italian reform seems to fit the framework since the adoption, in 1999, of the so-called 3+2 system. The first degree is the Laurea Triennale that can be achieved after a 3-year course. Students can then complete 2 more years of specialization which lead to the Laurea Magistrale. The "Laurea Magistrale" corresponds to a Master's Degree, and gives access to 3rd cycle programmes (doctorates). It should not be confused with Italian "Masters", less popular 2nd cycle degrees which do not give access to doctorates: "First Level Masters" can be pursued by those who hold at least a "Laurea triennale" degree, while "Second Level Masters" require a "Laurea Magistrale" before entry. Exceptions to the 3+2 system are the single cycle degrees: medicine (6 years, plus a postgraduate specialization), pharmacy, veterinary science, architecture and law (5 years).

The dottorato di ricerca (doctorate) requires 3 or 4 years of work and represents the higher level of Education for research.

The dottorato having been instituted in 1980 in Italy, first as a national institution (by the Education Ministry) second as a local institution (by each university) a new reform has recently been passed with the institution of the Schools , grouping several courses by faculty or university, depending upon the local non- homogeneous academic policy.

Quality

The Bologna process framework proposes[8] that each country should certify the compatibility of its own framework with the overarching framework according to the following procedures:

- The competent national body/bodies shall self-certify the compatibility of the national framework with the European framework.
- The self-certification process shall include the declared agreement of the quality assurance bodies of the country in question recognised through the Bologna Process.
- The self-certification process shall involve international experts.
- The self-certification and the evidence supporting it shall

[8] Ministry of Science, Technology and Innovation, Ministry of Science, Technology (DK), p. 10.