Digital Tools and Creative Practice in Architectural Research

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Recent developments in architectural research show a growing focus on research by design and creative practice research. New working modes are being established (in practice as well as in academia) which are a hybrid of traditional research practices in architecture and explorations in practice. In this paper we outline the characteristics, potentials, and possible future implementation of Research by Design and ask some fundamental questions about the implications for the field of CAAD.

Keywords: Research by Design, Creative Practice, Adapt-r, Design Research

INTRODUCTION

Research has always been part of architectural practice, and design is the core competence of the field of Architecture. Although it is tempting to uphold a distorted view of "pure research" taking place in academic institutes and "pure practice" in architect's and engineering offices, this simply can no longer be maintained as is evidenced by numorous research endeavors. Systematic inquiry in the foundations of architecture can already be seen in Villard de Honnecourt's lodge-book from the 13th century. Most high profile buildings from the 20th and 21st century such as Sydney Opera House, Centre Georges Pompidou, and Burj Khalifa show the important link between research and practice. Many of these modern examples rely on succesful multidisciplinary teams including architects, engineers and other experts. Poelman and Keyson (2008) document for less well-known examples in architecture and industrial design the role of innovation and research in design.

Much of the research described above takes place along well-established patterns. In this paper we want to point out that there is a change going on. Recent developments in architectural research show a growing focus on research by design and creative practice research. Typical for these endeavours is that the design work is a core and substantial component for the research process. Examples of such work can be seen in leading architectural offices such as Foster + Partners, HOK, Woods Baggins, ZHA, UN Studio, as well as PhD programmes such as the ones at KU Leuven - Sint-Lucas, University of Ljubjana, University of Cardiff and others. This phenomenon is not only visible in such high-profile offices and universities, but also becomes apparent in many young and smaller firms. At the same time we can observe a more narrow research and development cooperation between software firms, academia and businesses, and there are increased numbers of PhD researchers co-located in universities and companies (eg. the in-
dustrial PhDs as stimulated in Denmark, Belgium and other countries). At the same time, a growing number of PhD projects incorporate design activities in architectural practice.

In our view, this means that new working modes are being established (in practice as well as in academia) which are a hybrid of traditional research practices in architecture and explorations in practice. Not only in practice we can see new working modes, but also in academia research projects that are merged with practice are being explored. One of the most appropriate labels which can be assigned to this new way of working is Research by Design. In this paper we outline the characteristics, potentials, and possible future implementation of Research by Design and ask some fundamental questions about the implications for the field of CAAD.

RESEARCH BY DESIGN
Design research is more than taking care of repeatability (as known in science), transparency (humanities), theory testing and/or building (from social sciences): rigor, consistency and diligence need to be upgraded by imagination and by speculation... Design projects are projections into the future. Borrowing other disciplines through syncretic processes requires the creative process to become the focus of the research (Fraser, 2013), and this leads to the development of immanent methods of the process itself. Fraser also argues that 'we need to view design research as something distinct from Schön’s “reflective practitioner” (Schön, 1983), not least because the latter does not fully take into account the vital processes of knowledge creation in architecture'. The two questions Fraser points out are more than relevant: ‘Is design research in architecture something that is already inherent in the design practice, and simply needs to be identified and articulated in the public realm? Or is it something that still needs to be created anew, as a kind of step-change in the way in which architects/academics conceive of and produce their designs?’ We can add: (How) is it possible, that the awareness and the development of the ability to explicate the ‘tacit knowledge’ (Polanyi, 1966) inherent within the design process triggers other modes of new knowledge creation (…not ‘production’!…)?” Following Glanville it is indeed important to enlarge our understanding of research to include not only the way of knowing in the exact sciences, but to also include specific knowledge based on our experiences (artistic, aesthetic, social, etc) (Glanville 2012). How can we, in architecture, learn from other art and design disciplines? Some of the answers and also some new questions are potentially deriving within the ADAPT-r project framework through establishing a large community of research practice.

The European Association for Architectural Education (EAAE) established in 2012 in Chania, Greece, a Research Charter which was approved by the General Assembly. This Charter includes the following paragraphs:

In architecture, design is the essential feature. Any kind of inquiry in which design is the substantial constituent of the research process is referred to as research by design. In research by design, the architectural design process forms the pathway through which new insights, knowledge, practices or products come into being. It generates critical inquiry through design work. Therefore research results are obtained by, and consistent with experience in practice. (EAAE, 2012)

The Charter further values design as a way to create insight and understanding as well as the specific types of knowledge and ways of communication in architecture.

CREATIVE PRACTICE RESEARCH
Creative practice research is that research where the research is substantially embedded in a creative design practice. These are the research activities which are undertaken by the architect’s office to support the creation of new designs. Such activities typically are under more time pressure than traditional research projects in academia, and are more focussed to an immediately usable result. We can observe that such processes operate on shorter iteration cycles (faster) and with a high focus on functionality (does it deliver), realizability (can it be done), cost
(does it reduce cost), etc. and indeed, aesthetics.

The answer to the question of what exactly to research in a creative practice research project is simple: it is the inquiry into the ‘medium itself’ (Van Schaik and Johnson, 2011; Blythe and van Schaik, 2013). How to do? Taking all the ‘four main disciplinary approaches within architecture (building science, social science, humanities and art/design)’ into account (Rendell, 2004) brings the opportunity of bringing them together through designing. What happens when it is done ‘by design’? (Verbeke, 2013) And what happens then in the case of purified formalistic endeavours?

THE ADAPT-R PROJECT
The ADAPT-r (Architecture, Design and Art Practice Training-research) project is lead by the KU Leuven, Faculty of Architecture Sint-Lucas and strongly influenced by RMIT (Royal Melbourne Institute of Technology, Melbourne). The project further includes the Aarhus School of Architecture, the University of Ljubljana, Faculty of Architecture, the University of Westminster, the Estonian Academy of Arts, Faculty of Architecture and the Glasgow School of Art. The upgrade of the joint actions which took place since 2009 is a project within the EU 7th Framework of Research, more specifically the Marie Skłodowska-Curie Actions, ITN program, entitled ADAPT-r.

As stated at the project website (ADAPT-r, 2015) it ‘aims to significantly increase European research capacity through a unique and ground-breaking research model. At its core is the development of a robust and sustainable initial training network in an emergent Supra-Disciplinary field of research across a range of design and arts disciplines - creative practice research.’ The essence of the program is not just the development of the training model, but also the training of new researchers themselves - both at the PhD, the postdoc as well as the supervisor level. The training includes each of these levels of training in order to seriously increase the capacity to support the research on and through the ventures practices of the project fellows.

The professional institutional context of the project is enabled through a strong partnership network and embeds the research projects in SMEs (architectural practices, art and design offices, etc.) as a ‘substantial opportunity for real-world testing of the research and real-world training’. This usually lacks in more traditional research settings. ‘The research that is produced through the ADAPT-r ITN will contribute to a wider research effort to increase knowledge, understanding and quality of research in practice based creative disciplines and its methods.’ The ADAPT-r ITN will establish a deeper understanding of research in creative fields through funding 40 PhD Fellowships, 8 training conferences, two major research conference, a major exhibition, five key books, and a website providing public access to research and events. (ADAPT-r, 2015) Thus a new generation of (not just reflective) practitioners is introduced to the methods of creative practice research.

As such the ADAPT-r project (with the support of the European Commission) materializes and deepens a movement in architectural research where schools of Architecture show a growing interest in connecting their research to designing, design studio work and/or practice (EAAE, 2015). Where in most school of Architecture, there are only a limited number of PhDs ongoing in this direction, the ADAPT-r project creates a pool of 600 research months to reach the abovementioned goals, hence being one of the major endeavors in architectural research of the last years. The structural relevance of the research’ models like this is becoming a more and more important issues of the discussion (Verbeke and Zupancic, 2014).

To consolidate the findings of the first year, the ADAPT-r project organized the 1st Creative Practice Research Conference in Brussels, August 2014 (Verbeke et al., 2014a and 2014b). In line of the vision to organize research in the medium and through designing, the conference hosted plenty of exhibition presentations. Design studios were cleared and cleaned in order to host exhibitions, carefully reviewed and selected. Presentations took place within
the exhibition spaces. In fact, instead of presenting images or representations of objects/designs during the presentations of the research, the participants could show and refer to objects present in the exhibition space. The conference can be seen as one of the first fully peer-reviewed conferences which facilitate the communication of research findings through exhibition possibilities.

What is crucial in the ADAPT-r project is the fact that the researchers remain embedded in their creative practice and that the outcomes of the research are communicated through the medium of architecture itself.

POSSIBLE IMPLICATIONS FOR CAAD TOOLS
In view of the above development, it is essential for the field of architecture and the digital to engage in the discussion on the implications for the research. What are the implications and opportunities when bringing the new research paradigm of CAAD? How can we incorporate design as a way of developing understanding in our endeavors?

Within schools of architecture the following questions seem to be crucial when engaging research projects:

• What are the expected improvements for architecture, research, and digital design practice?
• How will schools & research institutes better integrate findings from practice?
• How will research findings from schools and research institutes better find their way into practice?
• How does this lead to more/higher funding possibilities?

Furthermore, how can we as a discipline contribute in a better way to society, to the quality of buildings, to the future of the world? How can we include in a strong way the experiences from all the designers working every day with design software? How can we channel these experiences into our research projects? How can we benefit from what is happening in architectural practices?

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Quadrics Theorems as an Introduction to Geometry, Parametric Design and Digital Fabrication

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The Caterpillar gallery was a teaching innovation project intended to integrate geometry, parametric design and digital fabrication at the earliest stage of the undergraduate training period. This paper shows the contents, based on this project, of the workshop carried out within the 33rd eCAADe conference, Vienna 2015. The geometrical principles -stemming from certain quadrics theorems-, the parametric definition and the digital fabrication of the reduced-scale model executed in the workshop are outlined and illustrated.

Keywords: Architectural geometry, Quadrics, Parametric Design, Digital Fabrication, Education

INTRODUCTION

The use of computation in architectural design has definitely opened a new paradigm in architecture (Terzidis, 2003). The focus of the new design strategy has moved from the object to the process itself. Algorithms acquire the role of the new means of representation as the language which translates human thinking for the combination power of computer-based processes. Indeed scripting languages integrated in CAD systems go beyond visual and mouse-based operations establishing a new way of interacting with the geometry involved in the project. On the other hand, the parallel development of digital fabrication perfectly matches with digital design tools, allowing a totally digital architectural process, from conception to materialisation.

This new paradigm places geometry in a new position with new roles. The explicit use of geometry is almost the only link between programming/scripting languages and architectural spatial relationships and forms. Compared with the conventional paradigm, this means major changes in the way in which geometry is applied, represented and even managed along the different stages of a project. In fact, the new relationships between applied geometries -descriptive, projective, algebraic...- and related disciplines in architecture -CAAD, programming, digital fabrication...- foster the emergence of a new discipline which integrates all of them together, Architectural Geometry (Pottmann, 2007).

The ways of thinking, conceiving, developing and materialising an architectural work are affected by the new paradigm. In most architecture schools, training matching this new concept is provided within postgraduate programmes. Nevertheless, just because the fundamentals are affected, the authors of this paper strongly believe -after years of tested teaching experience- that the implementation of the digital realm must take place at the beginning of the undergraduate training period, which is exactly the