

Competences for Digital Leadership in Architecture

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The use of "digital technology" - computer software, new material application, rapid prototyping, Computer Aided Manufacturing, Virtual Reality, collaborative design - is no longer a novel and innovative aspect of architectural design. In fact, many offices and architects use a varied mix of these technologies in their daily practice. We can observe that digital technology has become a mature part of architectural practice. In this paper, we want to outline an outstanding level of excellence in the use of digital technologies that enable certain widely acknowledged offices (for example Foster and Partners, UN Studio, BIG, and so on) to take their design work to high degree of quality and performance. We call this level and phenomenon "digital leadership." Digital leadership goes beyond technical digital skills. It is an integrated and holistic approach that makes no distinction between "architectural design" and "digital technology" and in fact creates a new blend of both. We propose that digital leadership has six key areas: Technological Ecologies; Creativity, Knowledge Processes, and Experimentation; Design and Research; Human Resources and Leadership; Collaborative and Explorative Environments and Impact of Digital Leadership. These are discussed in more detail in this paper.

Keywords: *architecture, digital leadership competences, research by design, creative practice, design research, impact*

INTRODUCTION

Digital technology has reached a level of maturity and is embedded in architectural practice, accompanied with well-developed research, but lacking the aspect of leadership and knowledge integration within the discipline of architecture, but also beyond

to the affiliated disciplines to avoid the effects of fragmented knowledge. Digital leadership is a novel concept that will dramatically improve the performance of creative industries to produce sustainable, effective, and meaningful solutions. This paper aims to develop the initial digital leadership competence ar-

eas and challenges the discussing about their potential within the eCAADe community. It builds on two eCAADe workshops organized by the authors of this paper (Verbeke et al. 2015, Zupancic et al. 2016) in which the concepts were introduced.

Digital technologies have become commonplace in architectural practice. Most of the regular design and production work is currently to some extent supported by digital tools at most of the architect's offices in Europe. Schools of architecture offer regular (but mostly technical) training in digital tools and media.

THE ROLE OF DIGITAL TECHNOLOGIES IN CONTEMPORARY ARCHITECTURAL PRACTICE

In March 2016, the Strategic Policy Forum on Digital Entrepreneurship delivered its final policy recommendations [1]. This recommendation asks for actions to re-skill our workforce, and building up innovative ecosystems to take advantage of the digital revolution. Architecture is one of the largest industrial sectors and is substantially behind when it comes to digital technology. Therefore, the interrelation of digital leadership and architecture need to be explored and developed.

Although there is a general acceptance of digital tools and media in the field of architecture, the state of the application in architecture concerns the support of traditional and conventional production processes of architecture. The application of digital tools and media does not yield any further competitive advantage since it is generically applied to almost all offices. Additionally, we see a saturation of computer skills in graduates of architecture, but this is not accompanied by a clear understanding of the how, why, and who. The innovative power of digital tools to advance the business of architectural design seems far underdeveloped. Knowledge is scattered and fragmented. The built environment requires integration, especially the integrated processes and methods for designing, building and maintaining the build environment in the sustainable framework. In the future the major challenge is

to avoid the current tendency of fragmentation and separation of these processes as different areas of expertise. Graduates need to develop interests beyond architecture (Achten 2008); architects always work in teams, teams need leaders; architecture is a business, architects can learn business skills; architects must sell and negotiate, focus on people and process, not only on product, and keep up to date with new technology. (Dobson 2014)

It is safe to say that application of and education about digital tools and media have reached a base level of competent application. At the same time, however, we can observe that beyond this base level, there are research institutions and architectural practices that are pushing the boundaries how digital tools and media can be used and developed. This is extremely important and relevant because the built environment is facing pressures that it cannot solve with the current state of knowledge, digital tools and media, and work processes:

- Sustainability; the need to reduce the carbon footprint of buildings, and preferably make them 0% [2], [3].
- Business process; management of increased complexity in client requirements, design team, stakeholder balance, time for design, quality guarantees in construction, FM, POE, and so on (Robinson et al. 2010).
- New materials and products: the main dependence of building industry on concrete, steel, and glass is expanding to especially low-carbon materials, such as wood and/or moisture resistant biodegradable composites and other new materials, not to forget include plastics, nano-materials, composites, and new production and manipulation techniques like Rapid Prototyping, robotics, and 3D printing of components and buildings (see e.g. the eCAADe Conference Proceedings of the last decade (CUMINCAD [4])).
- Well-being and quality of life in the context of the built environment, especially of the user-friendly adaptive solutions for technology-rich built environments.

These challenges ask for radical changes in processes and approaches. Artificial Intelligence (AI) and digital tools and media provide possibilities to change the workflow and impact of the profession. In order to develop this further, architectural and design offices are in need of people who can take a leadership role in innovating and enhancing the current working processes.

DIGITAL LEADERSHIP: GOING BEYOND CURRENT PRACTICE

As we have argued above, there are pressing needs on the Building and Construction Industry to address questions of sustainability and improve performance of the built environment. Several sources and authors indicate that these pressures cannot be solved with regular technologies and processes used today. We can see several architecture and engineering offices (for example Foster + partners, UN Studio, MVRDV, HOK, Ove Arup, and so on), as well as research centres (e.g. ETH Zurich), and educational institutions (e.g. The University of Stuttgart, CITA at the KADK) that are actively engaging these problems. All these organisations demonstrate leadership in the investigation and application of new technologies in research and practice. They inspire and push the boundaries of the field.

Apart from tackling the problems identified above, we see also that graduates of architecture are technically skilled to a certain extent, but do not have the knowledge and skill set to act as digital leaders neither in an academic setting nor in practice. We notice that the complexity of today's world and architectural design problems require approaches that are inclusive of as many factors as possible. The complexity and skills required to manage and innovate such processes well and to create good design solutions exceed the capabilities of traditional competencies for work processes and technologies. The most comprehensive technological platform and process models incorporated in the so-called Building Information Model (BIM) are not that well developed yet to support such approaches.

THE CONCEPT OF LEADERSHIP

Leadership is a term that originates mainly from organizational sciences. There is a great amount of research on the aspect how leadership is compounded of interpersonal skills and managerial skills (Vries et al. 2010), but the amount of research on leadership in a design context is almost non-existent. Pahl et al.'s (1999) review of 12 years' interdisciplinary empirical studies of engineering design in Germany shows that leadership in design is not well understood. In design, where often results are achieved through teamwork, leadership attitudes have an important effect on the quality. Lee and Cassidy (2007) discuss leadership in industrial design. They identify among others "the leader as a catalyst of organization change," which seems to be the closest to a "digital leader." Their list of good leadership traits includes interpersonal skills such as personal characteristics, maintain friendship, attitudes and values, leading styles, and proper roles. Adams et al. (2011) stress strategic leadership in cross-disciplinary teams. More specifically, among others, they identify the ability to "making or enabling conceptual connections," and "facilitating systems-oriented strategies or frameworks that leverage diverse perspectives" as important factors for leadership success. This view is supported by Buhse (2012), who stresses agile management as an important building block for successful Enterprise 2.0 business model, including aspects like the team-based formulation of agenda, goals, and strategies. He sees the digital leader as moderator, bridge builder, and network organizer rather than a classical top-down manager (Adams et al. 2011). Furthermore, active and passive leadership behaviours are crucial (Dóci et al. 2015). The authors of this paper take all these definitions of leadership and digital leadership into account while dealing with the digital leadership in architecture. This is due to the multidimensional definitions of architecture as a profession in general, that requires the widest possible variety of approaches to and from the digital aspects and leadership.

ARCHITECTURE AND DIGITAL LEADERSHIP

It has often been mentioned that developments in digital technologies are fast, and require constant updating of programs, hardware, and skills in the office, and the content of curriculum in architectural education. Often this is contrasted with a “traditional view” of architectural practice and education that is depicted as “slower,” “less innovative,” and “traditional.” This depiction has become so commonplace that it is hardly challenged. We feel that this picture does not reflect reality, and in fact does both fields of architecture and computing a disservice. Instead we propose that digital technologies are part and parcel of contemporary architectural practice, and we would do well to promote and support the synthesis of both. “Digital leadership” in this sense, means for us taking the lead in the constantly evolving practice and theory of architecture.

To summarize, based on discussions and workshops, we believe the following competences are critical for the contemporary architectural practice:

- Comprehensive knowledge to manage and innovate the use and development of advanced digital tools and media in architecture and closely related fields.
- Management and process knowledge of businesses to become effective leaders.
- Skill set to use analytical and research skills for leadership in design processes.

All of the above are of course set in the context of designing.

THE DIMENSIONS OF DIGITAL LEADERSHIP

To clarify the concept of digital leadership, we have distinguished six dimensions or key areas that are critical to this concept. We take these key areas as a practical working set for the time being. Only through engaging with these six key areas, will we be able to develop the descriptive and prescriptive values of the areas. Although these six areas emerged

from our activities and research, we see do not see them as fixed and exhaustive. Hence, it may be that in future versions we will need to adjust them. For now, we propose that the digital leadership concept thus integrates the following key areas: Technological Ecologies; Creativity, Knowledge Processes, and Experimentation; Design and Research; Human Resources and Leadership; Collaborative and Explorative Environments and Impact of Digital Leadership. This paper aims to discuss how the knowledge of digital competences, business management, innovation, creative leadership, design entrepreneurship and design strategy can be exploited to develop a deeper understanding of digital leadership competences. Additionally, each dimension provides us with an informal metric along which we can assess the degree or profile of the digital leadership of a person.

TECHNOLOGICAL ECOLOGIES

Technological ecologies impact the way design solutions can and are created. To create adequate and innovative design solutions, many aspects need to be balanced; these are often contradictory or unclear at the start. Design is both about exploration and stepwise learning about the design problem, and needs to incorporate knowledge from many people. Parametric design allows the systematic investigation of many more options than is usually possible in a traditional design process. Coupled with the architect’s knowledge and experience, parametric design has the potential to lead to better design solutions. It would be a mistake however, to view the design process as an isolated phenomenon from all the other aspects that are related to architecture, such as new materials, the construction process, collaborative design aspects, and so on. Many of these aspects are technological by nature. The “digitalisation” process potentially brings these various fields of knowledge and expertise closer together. For example, rapid prototyping technology lessens the gap between design model and materialization; laser scanners lessen the gap between surveying and the environment

model; virtual reality lessens the gap between the design and client; BIM/IFC lessens the gap between expert models in the design team; and so on. Obviously, in the mind of the architect such technologies are never seen in isolation, but now we can also witness greater coupling of these phenomena in the digital realm. Therefore, the possibility to synthesize many areas and aspects together is increasing with increasing digitalization of these technologies. What it results in, is not a collection of distinct technologies, but rather fields of connecting technologies; in other words, an ecology of technologies. The term “ecology” is used on purpose here to describe the interrelatedness of the technologies. In our view, an architect or firm that understands this “technological ecology” viewpoint, will better use such technologies, and create and realise potentially better designs.

We propose that a digital leader is capable to set up and maintain a technological ecology at his/her workplace. The digital leader understands how various technologies can be brought together in a fluent process. The level of competence can be mapped on a scale; at the lowest level this means steering or appointing a system manager to establish a technological ecology, moving towards increasing levels of personal commitment and contribution to innovation of such systems. At the highest level, a digital leader is responsible for most part of such an ecology.

CREATIVITY, KNOWLEDGE PROCESSES, AND EXPERIMENTATION

Creative processes are sources of knowledge and digital leaders can improve these processes. Creative processes have well been studied, in academic settings or based on the testimonies of practitioners and designers (Verbeke (ed.) 2017). Furthermore, already since Donald Schön (1983), reflection on activities has been stimulated to generate valuable knowledge. It is crucial for digital leaders to understand the underlying knowledge processes and they should be able to stimulate these knowledge creation processes amongst their collaborators. It is a way of

life-long learning and building on experience. It is also why most MBA degrees include a course on knowledge management. Consolidating on experiences and sharing and deepening insights is a crucial element for any organization to develop. Within a university context this is custom, but in architectural and design offices, these knowledge processes are currently less developed. Hence, we propose that any digital leader in the contact of architecture and design need to understand and be able to further develop such knowledge processes. At the lowest level, the digital leader should be able to recognize the value of developing and sharing of insights and knowledge, on the highest level, a digital leader needs to be able to initiate valuable knowledge processes amongst collaborators and help them to explicate and share their understanding.

DESIGN AND RESEARCH

Architecture comes into being through a long and usually chaotic design process. The aim of architecture is to contribute to and improve the built environment and hence, to provide a suitable context for the well-being of citizens. This implies that digital developments should preferably contribute to better processes in practice. Huge possibilities and opportunities have become available, but they are not yet fully exploited in architectural profession. Consequently, digital leaders need to be able to understand the fundamental aims and developments of architecture and its consequences for digital tools and media. On the other hand, digital leaders need to be able to incorporate possibilities and opportunities offered by digital tools and media to enhance the underlying design and research processes.

Hence, digital leaders need to be able to master design and research methods in such a way that they can point collaborators to opportunities and potentialities. Furthermore, they need to master research skills as developed in the ADAPT-r project (Architecture, Design and Arts Practice training - research, see www.adapt-r.eu) which allow practitioners to better understand what really concerns them, where their

architectural practice is aiming to, how they position themselves within the field and how they can explicate crucial elements and share that with colleagues (inside and outside the office).

Consequently, it became clear, that digital leaders need to master important research and development processes on the line between architecture and the digital. On the lowest level, a digital leader should understand and recognise such processes, on the highest level, he or she should be able to undertake research and develop a deep understanding of the processes and how they can be innovated.

HUMAN RESOURCES AND LEADERSHIP

From a management perspective, the interrelation between human resources, leadership modes and creative design processes is crucial. In order to further our understanding we need to explore the interrelation between human resources ("social and cultural capital") / innovative and transformative leadership and design/research methods; establish a theoretical framework of the interrelations discussed: supporting and guiding research and facilitating transitions to new research arrangements, for instance, to accomplish multidisciplinary approaches. This is how we can develop, for instance, leadership success strategies about design/research approaches and methods. We also need to understand the inclusive role of gender in digital leadership in/of architectural offices. Thus we can develop gender and also lifestyle sensitive leadership models. Furthermore, we need to investigate the drivers and triggers of knowledge creation deriving from interactions within communities of practice: dialectics of integration and individuation. This can lead to dynamic leadership models based on facilitating skills of group integration and individual autonomies.

We propose that a digital leader can identify the leadership modes appropriate for the specific working situation and take that role effectively. At the lowest level, he/she is able to arrange a group of collaborators, identify what motivates his/her collaborators and motivate them in using and applying relevant

digital tools and media. At the highest level, he/she is able to shift the leadership role depending on the specific situation, scale of group and/or institution as well as stimulate the development and use of contextual opportunities.

COLLABORATIVE AND EXPLORATIVE ENVIRONMENTS

The challenges of studying collaborative and explorative environments are manifold since they simulate, if not being, the real life world environments. The confidence and know-how of the built environment has a clear practice-based approach, wherein research, theory and practice are in genuine interaction with each other. Accordingly, the shared interest when building up innovative ecosystems to take advantage of the digital revolution in architecture is to study and elaborate integrated processes and methods for designing, building and maintaining of the built environment in order create a new theoretic base for sustainable architecture. Furthermore the aim is to contribute to the digitally oriented theoretical and methodological development of the research of interaction between human beings and the built environment. Hence, special emphasis is on a built environment that creates well-being and quality of life, as well as is based on user-friendly adaptive solutions for technology-rich built environments, such as the process of digital and structural design for fabrication and manufacturing. Although the themes of the studies vary, the interest is on present and future solutions in the scale of buildings and the urban environment in real life world context.

When aiming to take control of digital leadership of collaborative and explorative environments it requires strategic leadership of cross-disciplinary teams as Adams et al. (2010) suggests. Considering architectural practice the cross-disciplinary teams are formed project based and are therefore temporary organizations. Hence, there are great similarities with research project managing of temporary organizations (Herneoja et al. 2015), where according to Ernø-Kjølhede (2000) and Lundin et al. (1994)

team building is one of the most important aspects of managing the research project. In order to attend to the teambuilding digital leaders should have not only broad understanding of the possibilities of digitality within architectural design, but also knowledge of the digital interfaces between architecture and affiliated disciplines effecting to material and immaterial solutions of the final outcome (Herneoja et al. 2015). Thereby, digital leader should also have knowledge of the digital solutions beyond daily base maintenance to the entire life span of the building as well as of the digital solutions creating well-being and quality of life in built environment. As it is, digital leaders should have instead or in addition of narrow expertise of digitality in architecture quite broad understanding of possibilities of digital solutions in the long run, and have the skills and network of finding the experts also beyond the discipline borders of the field of architecture.

IMPACT OF DIGITAL LEADERSHIP

How does digital leadership help to contribute to change and innovation at different impact levels? At the lowest level this change means the incremental everyday impact. However, our vision is the need for a fundamental shift from digital support of architectural design to architectural directions of digital support.

We propose that a digital leader in architecture is able to identify the target relevance communities in scales and is also able to communicate with these target groups effectively. He/she is aware of the interrelationship of architecture and digital and leadership. At the lowest level the digital leader understands the extreme impact contexts of what he/she and his/her group is dealing with. At the highest level, he/she sees and relates to the colourful societal situation and to the in-between-ness of the impact potentials.

Hence, we believe that focus on digital leadership can push the field to its next level: a level where the digital and architecture are in full synergy and guide each other. Architecture guides the needs for the digital and the digital helps to push architec-

ture forward. Digital leadership brings a fundamentally new approach to the field which is so far mainly developed through technological possibilities while not itself impacting on the energy spent by software developers.

DISCUSSION

From the above elaborations, we hope it has become clear to the reader that a digital leader is not just someone who has a high level of digital competence. We see such a person as someone who manages to combine such competences with a high level of understanding of what is developing in architectural or design practice. It is someone who is able to manage digital ecologies to the benefit of the practice and the disciplines; someone who is able to induce learning and knowledge processes amongst collaborators, especially in relation to creative processes; who is able to learn from creating and implementing architectural projects, and to instigate critical reflection from his/her working environment. Furthermore, it is someone who is able to understand the required human resources for such developments and who is able to recognise and bring together the competencies to innovate and push the organisation forward to a new and unexplored innovative level. It will be clear that such all-encompassing endeavours can only be developed by establishing collaborative and inspiring creative working environments. Only then, we will be able to impact on the discipline as to consolidate the work and research in the digital in architecture and to give an answer to the challenges mentioned in the beginning of this paper.

We believe this requires a new mind-set where the technological developments are not the ones pushing the field, but where the added value is generated by experts who complement their design skills with research and management competences. We believe that such position could become part of a potential vision for the future of the discipline.

The competences of digital leader seem to be widespread and manifold, in short demanding. Thereby, it is most likely that variation of competence

in content and level of knowledge will differ between the digital leaders to confront the cross-disciplinary needs within field of architecture and beyond, with the affiliated disciplines. The purpose of this article is in addition of drafting the target profile of the digital leader, to stress the importance that specifically architects take the responsibility of digital leadership in architecture and not alienate it to the representatives of other disciplines or professions.

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