ICT and the architectural design process – introduction of an ICT impact matrix

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ICT has affected and influenced the architectural design process on several levels. The introduction of an ICT impact matrix attempts to contribute to a better overview of the ICT related impacts today on four essential aspects of the architectural design process: the generation of design solutions, the communication, the evaluation of design solutions and the decision-making. The exploration of the ICT related benefits and challenges is based on key points from previous research in the area. Furthermore, the matrix is based on the definition of three hierarchical levels: the micro-, meso- and macro-level.

Keywords: Architectural design process, ICT impact matrix, overview

1. Background

A fundamental pillar of a successful building project is a good design process. A primary idea for the project emerges in an architect's head based on an iterative process between problem and solution. Taking into account different constraints set for the project it "materializes", mostly in collaboration with a design team, into a drawing illustrating the fundamental project concept [1]. Within this process crucial decisions must be made, starting with the architect's decision, which solutions are worth being put to the paper, to the crucial client decision, which proposed concept should be further developed. The evaluation and decision-making due to a design solution, and the successful planning and realization of a building project, depends heavily on the success of communication on many levels. Schön's [2] description of the designers conversation with the drawing, or what Kalay [3] calls ideation or an intra-process role of communication represents one level. The dialogue between two individuals, the extra-process role of communication represents another.

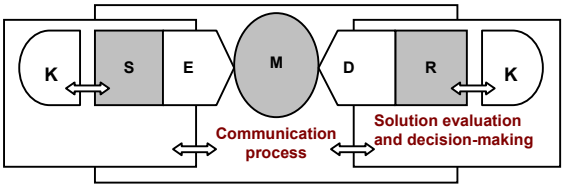

Figure 1: Illustration of relations between four design process aspects

Over the years, the impact of ICT has lead to dramatic changes within the construction sector average working day [4]. Working processes and role definitions have been affected.

The participants within the architectural design process face ICT related benefits and challenges at several levels. An understanding and overview of the ICT benefits and challenges within the architectural design process and decision-making can be crucial for the overall success of the building project.

The introduced ICT impact matrix could contribute to a better overview and understanding of the current ICT related benefits and challenges due to four essential aspects of the design process: the generation of design solutions, the communication, the evaluation of design solutions and the decision-making. Figure 1 attempts to illustrates the relations between these interdependent and iterative four aspects.

2. The ICT impact matrix

The ICT impact matrix is, in addition to the selected four design process aspects, based on the definition of three hierarchical levels:

- **The micro-level:** focuses on individual processes: e.g. the designer's conversation with the design situation, the decision which idea is worth being put to the paper etc.
- **The meso-level:** covers the mechanisms within the group, for instance the design team: e.g. collaborative design generation, decisions which concept should be presented etc.
- **The macro-level:** comprise the mechanisms on overall project level. Include all participants, as stakeholders, manufacturer etc. Decisions such as for example which concept should be further developed and realized.

The introduced matrix is not intended to force aspects of the complex architectural design process into some rigid categories, rather it can be a help in acquiring an overview and understanding of the inherent complexity of the building project design process.

Table 1:Outline of an ICT impact matrix

	Micro-level	Meso-level	Macro-level
Generation of design solutions			
Communication			
Evaluation of design solutions			
Decision-making			

3. ICT impact on meso-level

In the main paper, several ICT benefits and challenges due to the four design process aspects and the three hierarchical levels are explored and described. In the following, some ICT related benefits and challenges on meso-level design process aspects are presented as an example.

The generation of design solutions: Globalisation and growing complexity of problem and technology are some of the trends leading to the necessity of collaborative design.

The communication: The network technologies (e.g. e-mail, Internet) support design team communication, making collaboration possible independent of geographical and organisational borders. One major challenge is how to develop network technologies offering the communication possibilities necessary to solve complex problems or generate complex design solutions. The network technologies, databases, 3D product models etc. contribute to a better access to and distribution of information, thus allowing parallel working and a higher degree of transparency. Communication standards, as e.g. IFC, support interoperability between different ICT systems [4,6]. The ICT impact possibly leads to a blurring of traditional borders between different design team roles, as a blurring of the borders between the design team and the other participants within the building project.

The evaluation of design solutions: ICT tools as for instance virtual reality and 3D modelling can support simulation and almost real-world visualization of design solutions. An early recognition of inconsistency and conflicts is possible, relieving the coordination of the many interests inherited in a design team. However, such evaluation and simulation tools could force a level of precision not representative for the factual design situation and possibly strangle creative processes [1]. The ICT ability to store amounts of information makes a reuse of previous design solutions possible. The ICT storage, simulation and visualization abilities can support the reduction of uncertainty. Generally, it is problematic to judge and measure the qualitative aspects of the design solution.

The decision-making: Possibly the analytic, quantitative and explicit nature of the computer could disturb the balance between the qualitative and quantitative, tacit and explicit, intuitive and conscious. This could lead to a bias within a design team`s process of evaluation and decision-making, and can affect the total building quality negatively.

3.1 Conclusions

The introduction of the ICT impact matrix illustrates a possible way to approach the wide range of ICT impacts on the complex field of the architectural design process. The processes within the architectural design and decision-making can perhaps be compared with the nature of the design problem itself: as multi-dimensional and interactive, based on an interconnectedness of different factors. On the one hand, the four selected design process aspects: the design solution generation, the communication, the design solution evaluation and the decision-making are highly interdependent, as the figure 1 seeks to illustrate. On the other hand, the defined micro-, meso- and macro-level levels are closely interconnected. These issues constitute the main challenge and eventual problem area behind the ICT impact matrix. In a next step the matrix could be discussed and tested using e.g. real life projects. The interaction between the different levels, such as the relation between architect and design team, or between the design team and the client, could also be interesting to study. Further inquiry could lead to a modification of the ICT impact matrix, the three level approach and the choice of design process aspects. Generally, the matrix outline could be developed into a filter for deciding the direction and focus of further work and research. From an architect's point of view, a crucial question is how the ICT related benefits and challenges impact his role, influence and contribution within the architectural design process and decision-making.

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