

A Matter of negotiation: Managing uncertainties in an open design process

Sven Schneider, Technical University Munich, Germany, schneider@ai.ar.tum.de

Nancy Richter, Bauhaus-University Weimar, Germany, nancy.richter@uni-weimar.de

Frank Petzold, Technical University Munich, Germany, petzold@tum.de

Abstract

Designing is a highly collaborative and communicative process. To achieve good results effective teamwork is extremely important. Digital technology makes it possible for this process to be distributed across different spatial locations. Despite the potential of digital networks, commercial systems in the field of Computer Aided Architectural Design remain stuck in old patterns with strict role definitions and linear working processes. Open Architectural Design offers an alternative to this “sequential model” by providing an approach to distributed work oriented around “Open Strategies”. Open strategies facilitate an open exchange of ideas and artefacts with the aim of making better use of distributed resources and realising greater creative potential. The goal of our project is to apply open strategies to the architectural design process. The technical basis for our research is FREAC, a software framework developed in-house which provides a collaboration space for co-operation between different users and tools. This framework is designed not just for exchanging the outcome of the design process but also for opening up the design process itself and making it more transparent. Such highly open and distributed design processes, however, also present new problems and uncertainties which need to be taken into account in order to reach successful design outcomes. As a result proposals for the management of such processes need to be developed that facilitate collaborative work but do not unnecessarily constrain the inherent complexity of the design process. The focus therefore lies on the improvement of the negotiation process between users, tools and architectural design models. The actor-network theory, and other different management concepts, provides a theoretical underpinning for our approach. The project is a collaboration between the fields of computer science in architecture and media management.

Keywords

Collaborative Design; Open Design Processes; Actor-Network Theory; Media-Management.

Contemporary architectural design brings new challenges to the design process: internationalisation, digitisation, increased differentiation between disciplines as well as spatially and temporally distributed working methods. Effective coordination between different participants plays more than ever an important role in fulfilling the complex requirements of today’s building constructions and to achieve high quality results. Although the architectural design and planning process is now almost completely digital, computer-aided spatially distributed collaboration and the associated use of distributed expertise in the key phases of design have still be implemented successfully. While current developments in building information modelling (BIM) are centred around the integrative aspects of a common model, they focus primarily on effective data exchange and maintain a strict division of roles. Although the exchange of data is being conducted at a faster rate than ever before, the working process is still dominated by a linear and sequential pattern. According to the practice of designing, which typically deals with wicked problems (Rittel, 1973), such “a priori” hierarchically organised structures, hinder the emergence of creative processes and innovation.

The potential of digital technology lies not only in the acceleration of already established working methods, but also enables them to be restructured entirely. A good example of how structures are changing across many fields is the emergence of open development methods, e.g. open source initiatives in computer science (Raymond, 2001) or collective intelligence or swarm intelligence in economics (Levy, 1997). These make it possible to access and exploit decentralised skills more

effectively. "Open" thereby designates the free exchange of information, licenses, ideas, data and artefacts. How this exchange is designed varies from

case to case. Initial approaches to applying such open strategies to the process of designing are evident, for example, in "Wikitecture" (Chase et al, 2008), the urban planning project "divercity" (Königs et al, 2000) as well as in product design (www.theoscarproject.org). All these projects, however, lack suitable management strategy approaches for successfully facilitating a genuinely open negotiation process. Typical problems include issues of quality assurance and motivation, the enabling of coherent action, the mapping and storage of information and knowledge, and effective communication between actors.

Our goal is the development of techniques and methods to enable spatially distributed design processes based on such open strategies in the field of architecture. A key challenge of the project is to avoid hindering the creative process of designing in digital environments, in other words to create "enabling spaces". At the same time, it addresses approaches to coordinating processes occurring within these "spaces" without constraining their inherent complexity and unpredictability. In the following we introduce a technical and theoretical foundation that provides insights into how and with what mechanisms such open design processes can be controlled.

1. A technical framework for open architectural design in digital networks

In an open architectural design process the design object is constantly in development. The negotiation process, in which this object is changed, manipulated, newly created or discarded, is therefore not innately suited to a sequential chain of fixed stages but is instead characterised by simultaneity, plurality and the mutual production of interconnected information (see for example the work of Rittel (1972), Lawson (2006), Schön (1983) and others). Everyone involved is a potential actor that informs the design object by contributing ideas and skills (fig.1).

To exploit such networked expertise as accessibly as possible, a space needs to be created on a technical level that facilitates the act of contributing. For several years we have been developing tools based on our in-house experimental programming platform FREAC (Framework for Enhancing Research in Architectural Design and Communication). This platform provides a flexible data structure for the integration and linking of digital tools. It allows an open exchange and transfer between different users and provides a flexible technical framework for different research projects. The main aspects of this framework are as follows:

Seamless coupling of heterogeneous tools

Almost all collaborative design projects face the problem of having to develop interfaces between different tools. As a result, many projects are limited to an asynchronous exchange of data over the net in the form of web platforms, etc. These "interruptions" reinforce a phase-oriented working method and thus interfere with the flow of the creative design process. To facilitate networking as an open process, it is vital that the barriers between tools are kept as low as possible. Rather than using one complicated universal program, it should be possible to create and use many small, easy-to-use tools that can be seamlessly interconnected and combined as required. The FREAC platform uses a TCP client-server principle to effect communication between these tools. When changes are made to the digital model all clients linked with the server are automatically informed and can synchronise their local models. The resulting seamless coupling of different tools means that every tool can immediately "see" how other tools have affected the model and can build directly on the changes made. It also allows different tools, methods and technologies to be brought into direct relationship with one another, for example to seamlessly integrate a freehand sketching module into a 3D Modeling environment (Schneider & Petzold, 2009). The resulting content is therefore always linked to each other in one or the other semantic form, creating networks of design tools and artefacts. (fig. 2)

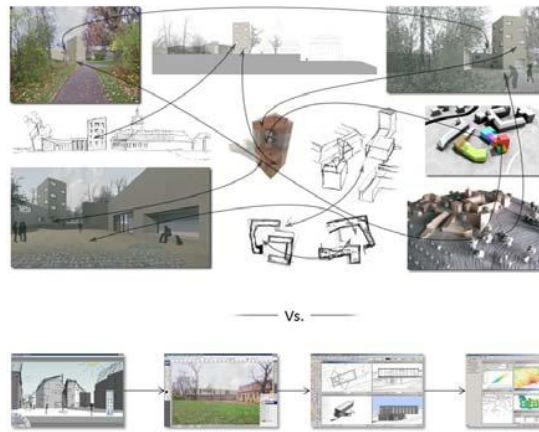


Figure 1 Different kinds of representation condition one another Vs. The Separation of these contents in traditional digital design applications

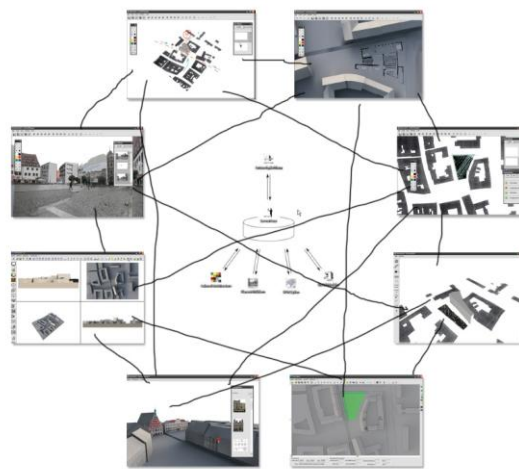


Figure 2 Via FREAC all (connected) tools are interlinked and form a complex network of heterogeneous data / content (video online at: <http://vimeo.com/8591465>)

Connecting users (seamlessly)

Negotiation processes within spatially distributed design actions is always mediated – by the digital tools as well as the design objects and artefacts created with them. These are stored on a server which all parties are able to access in real time using different tools. The seamless technical interlinking of digital tools and their users enables them to circulate freely and without barriers in the network. Modifications can occur both asynchronously and synchronously at any time creating a smooth transition between individual and group editing and facilitating the dynamic formation of networks (flexible group sizes) of human actors.

Storing processes (automatically)

The FREAC server can handle all kinds of data. Each item of data receives a reference detailing when it was created, with which client and by which user. Each reference can be called up, combined with others and interpreted selectively. To avoid unnecessary data load, the model only changes within the transactions, i.e. only the changes are saved, not the whole model. The aim is the emergence of an ordered structure that obviates the need to structure the data manually.

The technical framework is a basis for the creation and use of (design) tools and creates an open negotiation space for collaborative design projects. In the following, the theoretical foundation (from a management perspective) for capturing, analysing and evaluating designing in open networks is discussed.

2. The actor-network theory as a framework theory for an open architectural design model

The creation of technical networks is simultaneously the creation of social and organisational contexts and spaces of action and negotiation. To coordinate complex negotiation processes in such technical and social networks (different tools, content, users), it is crucial to make visible the processes taking place. The actor-network theory (ANT) is used to describe these multiple interactions between the actors in their necessary complexity. Decisive here is the acceptance of complexity, as a complex open design network is able to respond more innovatively and flexibly to changes and gives rise to creative synergies.

The actors play a key role in the ANT. They represent entities that freely interact within a network and behave in different ways. Their “capabilities lie in how they are able to affect other actors, how they change, transform or produce them” (Belliger/Krieger, 2006). A special aspect of the actors lies in the assumption that there is a coexistence or symmetry of human and non-human actors, who mutually ascribe one another actions (Belliger/ Krieger, 2006). As such, in the process of (computer-aided) architectural design, there are heterogeneous human and non-human actors that act differently within the network and influence one another mutually.

Besides the architect, expert planners and developers, one can also regard design objects, design tools, environmental conditions, laws, norms and institutions as contributing actors in the design process. In the ANT, so-called micro-actors such as individuals and single tools are treated equally alongside macro-actors such as institutions and organisations. While their differences are not denied, the construction of networks helps to uncover their differences and their available capacities and influence. Overall, the resulting design can no longer be seen as the work of a single actor, but as a net-work of all contributing actors, regardless of their importance or size. Although the network gradually stabilises over time, it can be understood as an open network: it is open to ongoing change produced by the participating actors, as well as any new actors that enter the process, and as such is in a state of permanent flux.

During the formation of networks it is assumed that the world is contingent, that is, that it does not have to be the way it is (Belliger / Krieger, 2006). Because they are able to bring about innumerable references and effects that emanate from something, selection processes are necessary to reduce complexity and create order. As each selection of “something” results in the introduction of a difference in the world, selection processes can be interpreted as actions. In the ANT these are generally referred to as translations and not attributed to humans or human-actors. “Translation is a complex process that consists of a number of different communicative acts, all of which are destined to construct a network.” (Belliger / Krieger, 2006). Actors become involved in a network “by ‘translating’ their interests and roles”, that is, by adapting their interests to one another to pursue a common direction. Translations in one or the other form therefore allow some form of cooperative action, since such joint action implies common objectives and interests (Belliger / Krieger, 2006).

Relationships between actors in open architectural design

The ANT extends our understanding of the design process as a matter of negotiation by considering not only human-to-human relations, but also actions that relate to objects. In the ANT, person-to-person relations are therefore complemented by object-to-person, person-to-object or even object-to-object relations, adding new dimensions to the notion of actions in the design process. In the Open Architectural Design process (using FREAC as a basis), the following relations have a significant influence on the digital design process and have therefore been considered in greater detail. Here we should note that the term “designer” refers to any human actor involved in the design process.

Data : tool relationship as an object-to-object relation:

The data : tool relationship describes how tools draw material from the data container and as such assume the role of an active actor in the network. The FREAC server provides an open data container, which can be filled with a variety of data that is then available to all other tools connected. This allows an exchange of heterogeneous information in real time.

Tool : tool relationship as an object-to-object relation:

This level of relationship examines the extent to which different tools interoperate with one another and how they are involved in network formation. The connection between different tools can occur, for example, by visually superimposing different tool contents. It can also occur by directly coupling or chaining the content or algorithms of different tools (e.g., building volume coupled with plan generator). Each new tool may therefore potentially change the structure of the relationships.

Tool : designer as a human-to-object or object-to-human relationship:

With tools, artefacts are created to articulate specific intentions and content, as well as to gain insight into the object to be designed. The designer as a human actor influences the design tool and likewise the design tools influence the actions of the designer. Crucial for designing in the digital space is therefore the ability to effortlessly switch between different tools and action spaces.

Designer : designer as a human-to-human relationship:

In distributed design processes, human to human communications are mediated by digital tools. As such, direct and indirect communication overlap in the interaction. The more “seamless” the connection between various actors within an action space is, the more direct and immediate their participation and their ability to form networks.

Designer : external constraints as a human-to-object relationship:

External factors such as environmental conditions, social-factors, laws, etc., are often difficult to transfer into the digital realm due to their specific context-dependency or their ambiguous form. To make them available to all the actors involved, they have to be translated into the digital model by the designers and the tools available to them.

At a technical (digital) level it is important that the different demands, ideas, constraints, rules, designers and tools can be integrated in a suitable manner to guarantee effective translation processes. The relationships between these actors influence the entire design process, and navigation, mediation and translation processes take place constantly between these heterogeneous components in the network. The more seamlessly they are integrated into the overall process, the more effective negotiation processes can occur and more easier networks can emerge.

3. Accepting and managing uncertainty and complexity in an open architectural design process

Open development methods, such as those suggested here for the creative design process, make it possible to effectively use and process decentralised skills and competencies. A complex network emerges with a high degree of variability (Malik, 1998). The more complex a network, the greater its behaviour spectrum and the more innovatively and variably it can respond to changes. At the same time, however, it is more difficult and challenging to keep it under control. Together with the emerging complexity, different sources of uncertainties appear, which raise questions about how to coordinate them effectively. Bruno Latour addresses, in conjunction with the actor-network theory, five sources of uncertainty in order to highlight the discrepancies between a sociology of the social and a sociology of associations (Latour, 2007). Below, four of these sources are used to address the most important uncertainties that have to be considered in an open design process in more detail.

The first uncertainty according to Latour lies in “the nature of groups”. He describes the fact that within a network actors are constantly regrouping, leaving traces that can be analysed (Latour, 2007). Accordingly, a network is never pre-existent but must always be assembled anew through association. It is here that the design process manifests itself as an open network formed by many actors into which many ideas and skills can flow. It is a fluid and constantly evolving network which has no stable structure.

The second source of uncertainty is concerned with the nature of actions. Human activity is not transparent, but a conglomeration of many, often surprising sources which have to be unravelled to be able to make statements about who is in fact acting (Latour, 2007). Accordingly, one never

knows who is actually acting. But if individual actions in the design process are difficult to identify, it is also difficult to coordinate and motivate these actors.

The third source of uncertainty – the nature of objects – describes that different threads of action intermingle arbitrarily, so that they rarely consist purely of human-to-human or object-to-object relations (Latour, 2007). Without objects / artefacts, architectural design processes would be unthinkable. Digital tools and the design object itself have an impact on the perception and the actions of the designers and the entire design process, and should accordingly be taken into account for the purposes of effective management.

The fourth source of uncertainty – the nature of the facts – Latour stresses that an object of study should always be understood as a controversial and not as an indisputable fact. In architectural design processes, we are always dealing with unfinished, incomplete and vague constructions of reality. There is, therefore, a permanent need for interpretation, which in turn depends on the experience and knowledge of the actors involved.

The uncertainties discussed above, which occur in an open design process, raise questions about the coordination or management of the heterogeneous elements of a network. Unlike in traditional management approaches (e.g., principal-agent theory), it is not sufficient to search for moments of indeterminacy in only one other subject (Schreyögg, 2003). So how can one coordinate processes that take place in constantly evolving networks in which it is hard to draw conclusions about who is actually acting, where the influence of non-actors must be considered and where interactions occur with artefacts and design objects that are interpreted individually by each of the actors but must nevertheless be identifiable by their core characteristic?

4. Coordinating negotiation processes in open design networks

In our project, FREAC serves as a digital platform that provides the negotiation space for an open design process. For this to work, mechanisms and tools need to be developed to manage this process in its complexity. Based on the aforementioned uncertainties, we examine a series of possible solutions as to how these can be coordinated in a virtual design environment.

4.1. Uncertainty about the nature of the groups

An open design network is characterised by instability and constant change. The coherency of actions and the consistency of the results therefore appears vague because, unlike previous approaches, they do not take place within a fixed structure. The ongoing changes to networks with no predetermined structure are triggered by the free, creative and networked actions of different actors. Human and non-human actors contribute to each other, initiating translation and network-formation processes, changing them, expanding or limiting them. Through the seamless coupling of different tools and the temporally and spatially distributed constellation of designers made possible by FREAC, a high degree of openness and flexibility is created. This openness in the design network must be coordinated to facilitate consistency in action and consistency in results. Bruno Latour assumes that groups are not held together by existing commitments, but that the social network is created by mediators (Latour, 2007). Mediators complement the actors participating in a network. They circulate between the actors, modifying, translating and transforming the ideas of one actor into other ideas. Therefore the actions of the actors have to be mapped. With the help of FREAC these different stages of development are recorded in a process-oriented way. With the information collected, including the intermediate steps and links that were necessary for their creation, navigation techniques have to be developed that make permanent changes understandable and thus possible to coordinate. Individual actors cannot and need not understand all the complex processes of change nor integrate them into their local activities. They select only the relevant change processes and accordingly adapt them for their actions. Their changes are automatically stored and in turn available to other actors and their adjustment processes.

4.2. Uncertainty about the nature of actions

The scope for actors in an open design network is much larger than in a linear design process. However, assigning actions to actors is more difficult and may lead to motivation as well as quality problems. A decreased level of direct external regulation must therefore be compensated for by increased self-control. In addition to a policy of seeing and being seen, digital tools can be used for storing and reading evaluations and feedback. Beyond that, monitoring occurs not only directly but also, and more importantly, indirectly through networked action. As anyone is able to partner with another actor, actors need to react flexibly to one another, continually adjusting their actions and their designs to each other. Monitoring, control and by implication also feedback is therefore already an aspect of the open design process itself. Each actor stands in the centre of observation and is himself an observer of all the others involved. Observation is not limited solely to other human actors, but can also be undertaken by digital evaluation and simulation tools. Feedback from other actors allows the actor to adapt flexibly to the expectations of their environment. As in an open and complex network one is not able to immediately identify who does what at a particular moment in time, open design networks can potentially be seen as a permanent space and stimulus for self-reflection (Bröckling, 2007). Through the seamless linkage of actors and the permanent and automatic saving of changes in the design process, a technical basis is created for such self-reflection and self-optimisation processes. The seamless coupling of actors establishes a 360 degree field of vision, which makes it possible for actors to continuously monitor, evaluate and compare. By recording changes in the design process, it is possible to trace actions to a specific tool, user and point in time.

4.3. Uncertainty about the nature of objects

Digital tools, design objects and other non-human actors such as norms and laws have a significant impact on the overall process, as well as on human action and human perception. Here we need to consider the affect of individual tools and the impact of their limited functionality and action-space in the design process. The use of a tool of any kind sets up a temporary 'world', which is limited or defined by the scope of the respective tool (its functionality) and its compatibility with other 'worlds' (which in turn are the product of other tools). For example, while using a volumetric modelling tool, one can design volumetric models and is therefore restricted to this view. Since the process of designing occurs in parallel at many levels of abstraction and scale, one needs to be able to switch between tools and the functionality they provide according to the respective situation. In the case of digital tools, a crucial aspect is therefore the ease with which one can switch – the smoothness of transition – from one tool to the next. In FREAC heterogeneous tools (sketches, models, drawings, simulations) coexist within the same design space and one is not so tightly focused on one tool (and its scope), but can move freely between different 'worlds'. The tools do, however, leave recognisable traces which can therefore be tracked and analysed.

4.4. Uncertainty about the nature of facts

When designing, constructs are constantly being negotiated and exchanged which need interpretation. This requires knowledge and competence on the part of human actors and means that design objects as boundary objects need to be robust and plastic so that they are able to constantly communicate meaning between different actors. "Boundary objects are objects which possess different meanings in different social worlds and yet are able to create a link between these worlds." (Rosler, 2008). In this respect, we are concerned with the mapping, storage, transfer and use of knowledge and information. In digital design processes greater importance is therefore accorded to the transparency and stability of knowledge and information resources than in linear hierarchical design processes. Human actors must accordingly possess the competence to interpret the structures and develop this ability constantly. In addition, they must be able to work and learn independently without direct instruction. Non-human actors, such as digital design objects must constitute and maintain a connection between the different worlds of knowledge. Overall, it is difficult to coordinate a negotiation network of completely heterogeneous components, since the interpretation of the different content itself is problematic. This is due not least to the fact

that their construction and interpretation depends on the specific knowledge of the respective individuals and is as a consequence highly subjective. Likewise, in many cases different tools are not directly comparable, and even artefacts created with the same tools can transport entirely different meanings, intentions, etc. Of course, ambiguity of meaning on the one hand and the specificity of the individual actors on the other can represent a creative potential that does not necessarily need conclusive clarification.

In the technical implementation, it is therefore necessary to establish connections between different virtual artefacts. These different pieces of information or artefacts must have some kind of semantic relationship to one another (e.g. a sketch belongs to a model from a particular viewpoint, authored by someone). Using this information, navigation structures can be derived which enable one to represent contextual links. Thus it becomes possible to browse between different states of artefacts, to derive and record intentions.

5. Conclusion and outlook

At the outset we discussed the concept of “open” as denoting the free exchange of ideas and artefacts, much in the same way that open source projects make their source data freely accessible. Using the technical framework FREAC presented in this paper, we extend this definition to open up the design process itself and understand it as a constant matter of negotiation. In this way, it is possible to facilitate the networking of actions by many different actors. However, open systems require efficient coordination mechanisms to keep the network under control, without – and this is the biggest challenge – limiting its degree of openness. The extent to which creative processes can actually be opened up, and whether this has added value for the quality of the results needs to be explored further. This paper has discussed a theoretical framework to assist in the conception of digital tools and design objects. In future work we will create coordination prototypes using FREAC, in order to extend “negotiation spaces” and manage them sensibly. Additional problems and issues relating to the management of these action-spaces can then be evaluated empirically.

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