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GUEST EDITORIAL

# Studying and supporting design communication

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## 1. INTRODUCTION

This Special Issue offers a window into the thriving research and practice field of design communication. It is of interest to researchers working on information processing, task coordination, and collaboration in design as applied to a number of domains, including engineering design, architecture and construction, industrial and product design, human-centered and interaction design, strategic design, and design and innovation management.

When surveying the literature on design communication, boundaries are difficult to establish because the field is broad. However, by outlining the design process as a social process and connecting to Schön's notion of *design as a reflective conversation with the situation*, we distinguish three complementary and intersecting ways of looking at the field that together form the backbone of this Special Issue: The first focuses on studying design communication as information processing, the second centers on connecting languages and representations, and the third emphasizes the aspect of creating understanding. Proposing these three ways contributes to the base of knowledge on how design communication enables designing and allows for progressing the design. In the next section, we provide a brief review of the field. We then continue by summarizing the contributions made in the articles and conclude with an outlook.

## 2. THREE WAYS OF LOOKING AT THE FIELD OF DESIGN COMMUNICATION

The first way is conceptualizing design communication as *information processing*. In order to structure a design problem, addressing the designer's information needs and questions of access, processing, storage, dissemination, and retrieval are of utmost importance. Information processing in design and

how it influences the designer's behavior has been prevalent in studies on design communication for many years. Research here focuses, for example, on the time spent on information search, the way designers gather information, what type of information is needed, and what aspects influence efficiency of information transmission. Through studies conducted in the aerospace industry, for instance, the field has shown that, on average, up to 80% of the time is spent on searching for information. Design engineers tend to search for information via face-to-face interactions rather than in a documentary source. During these face-to-face encounters, about two thirds of the information sharing in design groups dealt with the content, whereas one third of the communication was aimed at structuring the group process. Research also shows that to process information in an efficient manner, requirements should fit the information-processing capability of the project team. This is, for example, influenced by task complexity and task interdependencies. Tools and techniques to improve information capturing and information processing have been developed, for instance, to support capturing design rationale.

The second way is conceptualizing design communication as *connecting languages and representations*. The focus here lies on how information is generated and conveyed, how people interact through utterances such as spoken language and other media used, or how designers and other people interact with prototypes and the final product. Researchers have performed, for example, conversation analyses using transcripts from design meetings and have analyzed the effectiveness of design reviews related to what media are used. Studies on media of communication in engineering design have focused on comparing, for example, sketching face-to-face versus sketching through computer mediation. The field has shown that communication between designers and other stakeholders is influenced by the product and how it is represented graphically or physically. The act of drawing or prototyping is often not an attempt to depict a final solution but rather a means for helping designers wrestle with complex problems. Sketches, computer-assisted design models, renderings, or other representations such as physical prototypes function

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as boundary objects connecting languages between different people involved in the design process. A number of studies refer to the communicative potential of products and represent products as media, for example, between the designer and end users.

The third way is design communication *as creating understanding*. From the three ways of looking at design communication, this is perhaps the most explorative in nature. This is due to the complexity of observing and measuring understanding within the dynamic process of collaborative design. To measure this phenomenon, researchers have used concepts created in the field of shared cognition such as team mental models. Furthermore, studies have characterized what aspects influence the creation of understanding between team members and explore different ways of improving this process. They have also shown that improvement is necessary because both effectiveness of collaboration within a design project and the quality of the outcome of the design project are dependent on the ability of the team members to create shared understanding. In addition, research has suggested that rich storytelling with the use of prototypes and visual aids captures the viewpoints of all team members in a way that increases the likelihood of joint understanding.

The three ways of looking at the research field of design communication complement each other and are interconnected. The seven contributions in this Special Issue treat several aspects at once, yet they all emphasize one of the three ways of looking at design communication as suggested here.

### 3. THE CONTRIBUTIONS

The first article, “Formality in Design Communication,” was written by Claudia Eckert, Martin Stacey, and Christopher Earl. The authors argue that formality is one of the factors affecting effectiveness of design communication episodes. The paper argues that the perception of formality by participants in the design process and mismatches in expectations on the level of formality are a potential source of poor communication. By conducting a comparative review of their own documented case studies in a variety of design domains, the authors identified three layers of structure in design communication that can be more or less formal: the design process, the interaction between participants, and the representations of design information that are constructed and used. The article concludes that, for effective communication, agreement upon the expected degrees of formality and informality within the three layers identified is necessary.

The second article, “Facilitating Design Communication Through Engineering Information Traceability,” was contributed by Neven Pavković, Mario Štorga, Nenad Bojčetić, and Dorian Marjanović. It aims at improving the design process through resolving manifestations of ineffective information processing caused by gaps in information flows. This article illustrates the importance of traceability of design information in engineering companies, in which multiple stakeholders work collaboratively on developing an engineering system.

Within this context, traceability is necessary for judging the credibility of engineering information and for effective information sharing within large teams. The authors developed, built, and tested an ontology-based traceability system to bridge gaps in information flows.

The third article, “Scaffolds for Design Communication: Research Through Design of Shared Understanding in Design Meetings,” was written by Jelle van Dijk and Remko Van der Lugt. It demonstrates the value of representational artifacts as media. Through the theoretical lens of embodied cognition and by means of developing and testing two interactive prototypes, their study shows that such representational artifacts leave physical traces of the design process. Their results also show that through the use of these interactive traces, participants display a subtle and fluid intermixing of reflection and social positioning. The authors claim that it is the ensemble of social and physical interactions that together grounds the formation of shared understanding in teams.

The fourth article, “Design as Communication in Microstrategy—Strategic Sense Making and Sense Giving Mediated Through Designed Artifacts,” was contributed by John Stevens. It also explores the role of designed artifacts as communication media within and outside the design team. The article focuses on the role of designed artifacts in the formulation and communication of strategy in an organization. The author integrates literature on design communication, strategy literature in management, and practical examples gained through an interview study. Based on these three sources, the author implicates that the designers’ sketches, renderings, models, and prototypes can and do play a role as symbolic resources in sense making and sense giving activities such as strategy formulation. Designers and their way of communicating might thus positively impact strategic decision making and change in an organization.

The fifth article, “Communicating Actionable User Research for Human-Centered Design,” was written by Celeste Roschuni, Elizabeth Goodman, and Alice Agogino. It describes the challenges of creating understanding in boundary-crossing communication within the particular setting of communicating user research. Through interviews, workplace observations, and the literature-based development of a conceptual framework, they study the concepts of translation and inertia as influences on the success of the researcher-client relationship in user research communication. The authors introduce the term *double ethnography* to explain that designers themselves are users of user research and argue that the results of user research should be presented in a human-centered way. This may be achieved through storytelling and creation of personas used as boundary objects. The authors also provide a summary of techniques to overcome translation and inertia problems while using double ethnography.

The sixth article, “Articulating (Mis)understanding Across Design Discipline Interfaces at a Design Team Meeting,” was contributed by Rachel Luck. It highlights ambiguity, characterized as lack of information, and uncertainty, characterized as lack of clarity, as two different ways of how

misunderstandings are manifest in design conversations. With data from a 6-month ethnographic study of the design of a building, the author describes how conversations in multi-disciplinary design meetings unfold. By using conversational analysis, the article shows that ambiguity and uncertainty are no neat, discrete phenomena but are interwoven in the conversation. During these conversations, not only were the team members sharing information and coordinating but also the design was progressing during the meeting. The coevolution of these aspects makes disambiguating misunderstandings difficult. The article concludes with implications for information systems design to support design communication.

The seventh article, “Social Learning in Design Teams: The Importance of Direct and Indirect Communications,” was written by Vishal Singh, Andy Dong, and John S. Gero. Through a series of computational simulations with team members as agents in the model, the authors discuss the effect of direct and indirect communication on social learning and task coordination in design teams. Results in the paper suggest that flat teams facilitate the formation of transactive memory, while functional teams are more appropriate for efficient task coordination. Reduction in communication and learning opportunities are more detrimental to task coordination in flat teams as compared to functional teams. Indirect communications contribute more to the formation of transactive memory than to task coordination. The role of social media in transactive memory formation for distributed teams is hinted at and implications of results are discussed for design teams working on tasks where task coordination is the key performance rather than the creativity or novelty of the design outcomes.

#### 4. OUTLOOK

In the rich tapestry of studies portrayed in this Special Issue and the variety of research approaches and methods used, we see a number of developments in design communication research. For instance, the field seems to be moving from describing practices of how information is gathered and shared toward asking what are problematic aspects of information sharing (e.g., different perceptions of formality and lack of traceability) and how we could overcome those to make information processing more effective. We also see a development from asking how information might best be connected and represented toward asking how an active and embodied engagement in the design process might best be supported, for example, through multisensory digital–interactive media. We see that investigating human design communication in *real* design practice is complemented by hypothetical situations using agents in a computational simulation. New perspectives are opened by showing how the strength of design communication can be benefitted from in social processes such as user research and organizational strategizing.

The contributions in this Special Issue exhibit a continuously active field of design communication with new and challenging research questions and application domains that will attract lasting industrial interests. The Special Issue represents

the next step in research on design communication seen from a social perspective. This is an exciting step as we move forward from descriptive studies in which we focused on understanding the nature of design communication toward studies that aim to support and improve the complex process of design communication. By taking this step, we transform our understanding into something tangible, which is the core of design (research).

#### 5. THE ARTICLE SELECTION PROCESS

Thirty-eight abstracts inclusive of the presentations in the two workshops were received, leading to 21 full-paper submissions and the inclusion of 7 articles. A number of events preceded the final composition of this Special Issue. Following an open call, a request for expression of interest was issued, and two workshops on design communication were conducted. The first workshop was part of the 4th International Design Computing and Cognition Conference, held in Stuttgart, Germany, during July 2010. The second workshop was part of the Design Society’s Special Interest Group on Human Behaviour in Design, convening at the 18th International Conference on Engineering Design, held in Copenhagen, Denmark, during August 2011. Workshop discussion and presentation themes included theoretical lenses used for studying design communication, processing design information at human and technical interfaces, representations in design communication, methods and tools for supporting communication in (collaborative) design, and future research on design communication. As a synthesis of the discussions, the three ways of looking at design communication, as presented here, was cocreated with all participants.

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