Dilemmas 2015 Papers from the 18th annual International Conference Dilemmas for Human Services: Organizing, Designing and Managing

Designing the interactive relations of complex systems

Ocean operations as research resources

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Abstract

My research aims at developing knowledge in the design of maritime systems by developing a new understanding of interactive relations. I have chosen to study a basic maritime operation at sea using dynamic positioning systems, as well as other operations associated with this basic task management throughout a maritime operational action. In following offshore operations in different offshore oilfields, I have observed and interviewed bridge operators, captain, crewmembers on the ship's deck, and engine engineers in their workplace. I found that how humans cooperatively interact with maritime operating systems is reflected in human performance related to daily work management. However, cooperative work is insufficiently supported by current maritime cooperative systems. Thus, I argue that interactive relations should be taken into account to improve the design of cooperative systems. In line with this, I incorporate insights from Computer- Supported Cooperative Work (CSCW) and using awareness as a concept in ANT to gather, cook and interpret data from field work in order to achieve a better design of cooperative systems.

Key words: Cooperative systems, design, maritime operations.

http://dx.doi.org/10.15626/dirc.2015.14

ISBN: 978-91-87925-74-0

Introduction and Research Questions

Traditionally, systems were designed and evaluated on an individual-oriented basis; that is, they were meant to understand the interactions between a person and an operating system (Rosson & Carroll 2002). Most computer systems and devices have been designed by following this ideology. With the development of technology, however, operating systems have become increasingly advanced and complex. Operators have to cooperate work in computer systems. Hence, researchers started to think that the systems should be designed based on the performances and perceptions of a group of users (Redish 2007). For example, in order to understand how people use computer systems, several designers observed workplaces to learn about work practices in reality (Redish 2007). The aim was to understand the operator's activities as a hierarchical structure during the interaction process, such as accounting systems, bank systems, and aviation (Redish 2007). When designing and managing such computer systems, most researchers collect individuals' work together to promote design guidelines for cooperative systems. Given that understanding is a non-waterfall-based design process, that is, it is meant to analyze individual tasks and subtasks by identifying and organizing them as successive choice and actions, it effectively defines cooperative work as a hierarchical structure. However, this may not be appropriate for computer systems where multiple operators, and subsystems are distributed in different places. In this case, computer systems, grounding environments, and the people who work cooperatively in systems are discounted. Hence, when only considering the complexity of systems, the systems may lose some soft goals; among these, safety is the most important factor because it is the fundamental requirement in high-stress jobs, including marine, nuclear, aviation, train, and air traffic control fields.

If we suggest that the cooperative work in computer systems does not follow a hierarchical structure, how should we organize and characterize its structure? For cooperative work, observation cannot simply involve looking at individual interactions. Rather, the relations between each individual interaction should not be discounted. As Sørgaard (1987) argued, cooperative work is nonhierarchical: Cooperation "is to work or act together for a shared purpose. The work is done in an informal, normally flat organization." For maritime operations, operators on the ship bridge and other places carry out tasks like a flat organization. In one offshore task, information is managed and transmitted among operators. This represents a back-and-forth information transformation process that incorporates all operators, tools outside of operating systems, and the operating systems. Individual work cannot be easily separated from other elements such as systems, other operators, and tools. Hence, the research question becomes the following: How can interactive relations facilitate the design of cooperative systems? How operators manage their work cooperatively with complex systems, as well as taking the work environment into account?

Methodology and Theory

Since I aim to understand the interactive relations in complex systems, I have incorporated insights from CSCW. The reason for this is that CSCW has a long tradition of analyzing cooperative work (Grudin 1994). Moreover, CSCW has the capability of analyzing work among human and nonhuman actors (Schmidt 2011); it emphasizes how tasks are managed and organized in different works, including the artifacts or systems by which they are organized and supported (Schmidt 2011). Specifically, I use observation and interview in CSCW as a basis for pitching a new path for interpreting awareness in designing systems in reality. The purpose is to build up design approach of cooperative systems. Hence, the insights from CSCW are used to fill in the missing area that most scholars have discounted in the current understanding of interactive relations. This is important for analyzing the fieldwork data in my project, as it helps to investigate relations through people's everyday behaviors and verbal sentences.

For awareness (Schmidt 2002), I would like to use this concept to understand of how people actively determine their locations in using maritime operating systems. Since operators on vessel are located in different places when they interact with the maritime operating systems/subsystems, the awareness emerges as a matter of static user location, and then the notion is extended to reflect movement. For example, when running dynamic positioning systems, engineers in the engine room, bridge crews, deck crews, and platform crews are located in different places as nodes in a network. This network changes from task to task, but the main influences on bridge crews' work come from maritime operating systems and communications. Because maritime operating systems on the bridge are core computer-mediators for operational tasks, different task contexts are used to support context-aware maritime operating systems. In maritime work practice, users employ location to tailor interfaces, refine application-relevant data, increase the precision of information retrieval, discover services, make user interaction implicit, and build cooperative environments. According to Schmidt (1992), in cooperative work, awareness is connected with action. In maritime operations involving computer systems, awareness is not a process that involves collective situations of individual work; rather, it is defined as being aware of a particular work procedure and management.

In order to realize the above understanding of interactive relations, actor-network theory (ANT) is a natural choice for the theoretical basis for cooking data from the fieldnotes. ANT offers considerable analytical traction with regard to being able to view the interactive relations constituted by fluid, dynamic, multiple, and emergent relations with relevant operators, hardware and software systems, and tools outside of operating systems. As described above, maritime operations as research resources exhibit naturally distributed work locations and cooperative work; multiple operators participating in the complex work environment. Hence, by utilizing ANT as a theoretical lens to manage the relations among human and

nonhuman participants in maritime operations, I aim to analyze, and interpret fieldwork data systematically as networks to establish a methodology.

Problematic Issue

Now I am in the middle stage of my PhD work and face challenges with illuminating the relationship between the new understanding of interactive relations and design practices. How to translate such relationship as a toolbox to service designers in practices? As Suchman (2002) argues "A longstanding mutual dissatisfaction between research and product development arises from the failure of technologies and ideas to "transfer" from one to the other, understand by on side to take advantage of the results of research, and by the other side to address the needs of development". There is a significant distance between design research and design work. Researchers (Dekker, Nyce and Hoffmann 2003) suggest that we need to step further and should be more supportive to service other people who also engage in design work. Only data collecting is not enough because we need to analyze data to ascribe meaning to it by delivering products that can be used by other disciplines. Hence, topics of my uncertainty include, but are not limited to, the following: How to translate data from my qualitative study into a methodology that can be used by design practitioners? E.g., ANT thoughts may difficult to be accepted.

Level of Progress

I have finished collecting fieldwork data on cooperative work. Currently, I am focused on writing up the findings from the fieldwork and promoting a systematic way of evaluation interactive relations in complex systems via traditional data analysis. The results already achieved in the past study point toward themes wherein the interactive relations in computer systems are explored as a network-based understanding of computer systems.

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