Chapter 2.12
A Design Framework for Mobile Collaboration

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INTRODUCTION

Mobile collaboration involves people working together and moving in space. Research in mobile collaboration has primarily focused on technical issues like connectivity support or remote information access. We argue there is a lack of research on many nontechnical issues vital to design mobile collaboration systems, disentangling the relationships between collaboration, work context, and mobility.

Our fundamental concern is to go beyond the technical issues towards the assimilation of the mobility dimension in all processes shaping collaborative work, including information sharing, context awareness, decision making, conflict management, learning, etc. This article aims to codify into a design framework:

- Some fundamental human factors involved in mobile collaboration.
- Several guidelines for developing mobile collaboration systems.

The design framework provides general constructs identifying phenomena of interest necessary to inquire about the work context, human activities, and system functionality. The framework identifies *what* information may interest designers, bounding their relationships with the other stakeholders. The framework also guides the design process, identifying *how* user requirements may be applied during the implementation phase.

The framework has been validated in several real-world design cases. Two cases will be briefly described. This research contributes to the design of mobile collaborative systems. The most significant contributions are related to artifacts and emphasize that designers shall explore the potential of artifacts to support concerted work and sensemaking activities.

BACKGROUND

Several conceptual frameworks have been proposed in the group support systems (GSS) field (DeSanctis & Gallupe, 1987; Nunamaker, Dennis,

Valacich, Vogel, & George, 1991; Pinsonneault & Caya, 2005). However, these frameworks capture the notion of place in a very restrictive way, more tied to group proximity than mobility, where geographical references play a central role in tying information together (Mackay, 1999).

The above limitation is being tackled in two closely related research areas: collaborative spatial decision-making (CSDM) and spatial decision support systems (SDSS) (Nyerges, Montejano, Oshiro, & Dadswell, 1997). SDSS address the combination of DSS with geographical information systems (GIS), while CSDM studies the integrated support to collaboration, decision, mobility, and geographical information.

We find several studies on the infrastructural basis of SDSS. Zhao, Nusser, and Miller (2002) identify the infrastructural requirements for SDSS. Gardels (1997) and Touriño et al. (2001) contribute with the integration of multimedia with geo-referenced data. Hope, Chrisp, and Linge (2000) tackle the access to remote databases by fieldworkers, while Pundt (2002) addresses data visualization in the same context. All of these research projects do not directly address mobile collaboration but explore basic features necessary to support this functionality.

Regarding the human factors of SDSS, we account for studies of user interaction with multimodal and tangible GIS interfaces (Coors, Jung, & Jasnoch, 1999; Rauschert, Agrawal, Sharma, Fuhrmann, Brewer, & MacEachren, 2002). In the same line, we also cite developments in synthetic collaborative environments for geo-visualization (Grønbæk, Vestergaard, & Ørbæk, 2002; Manoharan, Taylor, & Gardiner, 2002). However, these research studies address fixed work settings.

More in line with collaboration studies, we find several research emphasizing the need to support group modeling in CSDM (Armstrong, 1994, 1997). Some propose very specific solutions, such as the integration of workflow management with SDSS (Coleman & Li, 1999).

Finally, addressing the broad-spectrum CSDM design, we find the work from Tamminen, Oulasvirta, Toiskallio, and Kankainen (2004), who propose an integrated framework with guidelines for eliciting innovative ideas for mobile technology based on context-awareness (although not collaboration). Nyerges et al. (1997) also propose an integrated framework for CSDM, but the framework is specific for the transportation context.

As demonstrated by the research previously cited, there is a whole new perspective over GSS brought by the mobility dimension, making CSDM quite distinct from GSS. However, the most important distinctions are not captured by current GSS and CSDM frameworks: (1) the central role of geo-references in the information architecture; (2) the interaction support to obtain, manage and share geo-referenced data while in the field; (3) the role of geo-references in modeling group work; and (4) the added impact of context awareness in the system design, regarding in particular work place mobility. Our perspective is that we need to integrate these various phenomena into a meaningful and purposeful framework.

THE FRAMEWORK

The framework is bounded by two major requirements: It has to be open for exploring and interpreting mobile collaboration in various settings, thus requiring relatively abstract elements and constructs, and it has to link them in a purposeful way. Our major goal is to set the initial boundaries for inquiring about mobile collaboration, setting at the same time a design roadmap.

The framework, shown in Figure 1, is structured around five basic elements and four design phases. The basic elements are teams, tasks, artifacts, and places, while the design phases consider data collection, work analysis, prototyping, and value determination. As described below in more detail, the basic elements have an important role throughout the design phases,