

Human oriented mobile system for on-site problem solving

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ABSTRACT: Uncertainties and the dynamic nature of on-site activities require complex coordination of information, resources and tasks. Problems caused by unanticipated events must be solved concurrently and should avoid project delays and costs increasing. For effective solving of such problems, the immediate availability of information and a prompt response of project participants on various levels of project organization are crucial. A combination of both conditions facilitate the optimum decision-making in cases of unanticipated events. Based on experiences from a series of experimental projects called E-site, it is our strong belief that a large amount of potentials for on-site problem solving lies in the knowledge, experience and capability of the site staff themselves. Therefore, there is also a need to effectively link together the rich knowledge and experience of site staff and include site staff into problem solving processes. This paper describes a human oriented on-site problem solving system supported with context-aware communication to help dealing with unanticipated events on construction sites.

1 INTRODUCTION

Each day on a construction site brings new problems. The solution of daily problems in the construction process significantly affects the building and general project process, due to unanticipated events. Although unanticipated events can not be prevented, they can be managed effectively. It is our strong belief that a large amount of potentials for on-site problem solving lies in the knowledge, experience and skills of the site staff themselves. A proper mobile interpersonal communication network can link together the rich knowledge and experience of site staff and facilitate information exchange when solving problems.

Mobile computing, including mobile and ubiquitous applications as well as wireless technologies provide interesting approaches to supporting people to interact with other persons (Johanson et al. 2004, Beyh and Kagioglou, 2004), to find out about people's availability through location detection (Burrell et al. 2002), and to reach and manage information items even though not being present in the office (Fleck et al. 2002). In case of building ad-hoc mobile teams for joint problem solving a combination of mobile computing approaches is needed with emphasis on interpersonal communication. Therefore, this paper focuses on presenting interpersonal communication by on-site problem solving process supported with context-aware communication.

2 KNOWLEDGE SHARING IN ON-SITE PROBLEM SOLVING PROCESS

2.1 *The E-Site Experience*

Observing on-site interpersonal communication characteristics in a series of experimental projects called E-Site we identified importance of informal communication by on-site problem solving process (Magdic et al., 2004). When dealing with a specific on-site problem quick solution is needed, immediate availability of information and a prompt response of project participants on various levels of project organization are crucial. Often, just open and direct project-wide communication is what contributes to the successful problem solving, enabling all participants to be permanently, actively involved.

In case of solving specific problem it was evident that all involved persons were experienced workers. Instead of formal, specified communication, they used spontaneous, informal communication which enables them to rapidly and continually exchange information, monitor progress, and learn about what others are doing.

2.2 *Important aspects*

Four aspects can be identified as important for the purpose of supporting on-site knowledge exchange: interpersonal communication, presence awareness,



common information space and project organization hierarchy.

Interpersonal Communication

Not only knowing who knows is important when finding things out in order to solve a problem, but also to be able to communicate with others. This can be accomplished through either short notifications, longer chats, e-mail, sms, telephone calls, or face-to-face communications. Which communication channel is used depends on, among others, the persons involved, on the distance at the moment, on the availability of systems and on the character of the problem.

Each communication channel has a separate user interface, which each have access to the contacts database. Thus when initiating communication first the channel and then the recipient is selected. This is a channel-oriented approach to person-to-person communication.

People often start communication in resolving a problem not by choosing the communication channel, but with choosing the person with whom they want to communicate. Therefore there seems to be a need for complementing the channel oriented approach with a person oriented approach e.g. integrate the communication channels into the contacts database instead.

Presence Awareness

Our observations showed that how people conduct their search for knowledge and skills in order to solve a problem depends on the situation, on who is around and available at the moment, and on the nature of the problem itself.

How awareness information is presented may also be an important consideration. If an awareness system uses i.e. sensors or electronic calendars, to capture information about people's activities and availability, the information can be presented as it is, leaving it for the user to interpret where the person is and when will be available again. Another possibility, based on usage statistic, would be to compute a presentation that would be the most likely interpretation.

Increased availability may lead to an increased amount of annoying interruptions, therefore privacy aspects can be dealt with by letting people decide for themselves who should see their information and who should not.

Common Information Space

When solving problem on site Common Information Space should provide the user with one point where all already existing information (documentation, internal company's information) can be searched for

knowing who does what, who knows what, and where and how people can be reached. Certainly this could reduce the number of persons asked when solving a problem.

The structuring of the information could be created using ontologies or even better indexing (Google) without providing any structure of the information.

Organisational Barrier

Informal communication means a direct and open communication, which shows additional benefits in cases where problems must be solved instantaneously.

In the existing project organizational structures the chain of command or information gathering is inherently hierarchical. The hierarchical status determines the roll and authority of the individual subject, which is the main reason for the lack of effectiveness continuous on-site problem solving in the construction process and on the higher project level.

Lack of efficiency shows the need for transformation of the multilevel organizational structure on a single (flattened) networked structure. In this way, decisions are also made on lower hierarchical levels or on levels in the organisational structure where they are necessary (Figure 1).

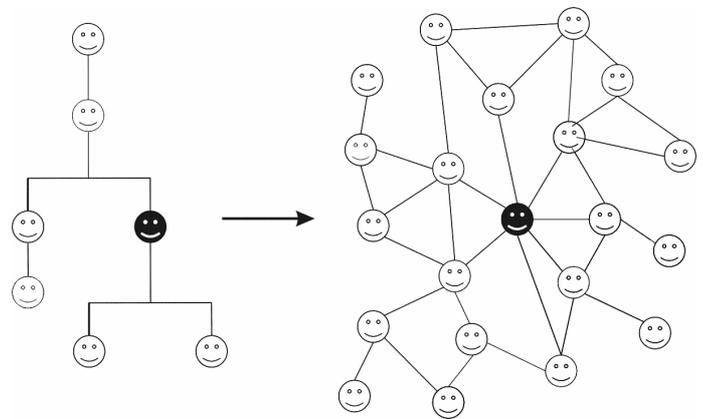


Figure 1. Novel decision and organizational structure

Our further activities within E-Site project are also related to optimize decision processes, and through the change of the decision model to develop an essentially optimised generic organisational model. In the frame of the created model, we will also define the responsibilities, authorities, and competencies of individual participants.

3 SUPPORTING ON-SITE AD-HOC COMMUNICATION

Informal ad-hoc communication between remote team members can be supported via tools for lightweight interaction (Whittaker et al, 1997) such as



phones, e-mail, instant messaging, shared workspaces, and awareness technologies.

Focusing on supporting on-site personnel in knowing about others' availability when initiating communication in problem solving process we suggest a pragmatic human oriented solution.

Our solution suppose when initiating informal communication people already know who to contact, which is also the case in on-site practice. Since by problem solving quick solution is needed it is important to know if our contact for solution is available or at least when he will be available. One could easily use mobile phone and call his contact hoping to get a response first and if there is no response the procedure is repeated with another contact again not knowing if it's available.

Therefore, system should provide the user with context information about potential contacts. We propose a sort of electronic secretary that combines context information from company's instant messaging system and electronic calendars and on request transfers this combined information via different clients (Figure 2).

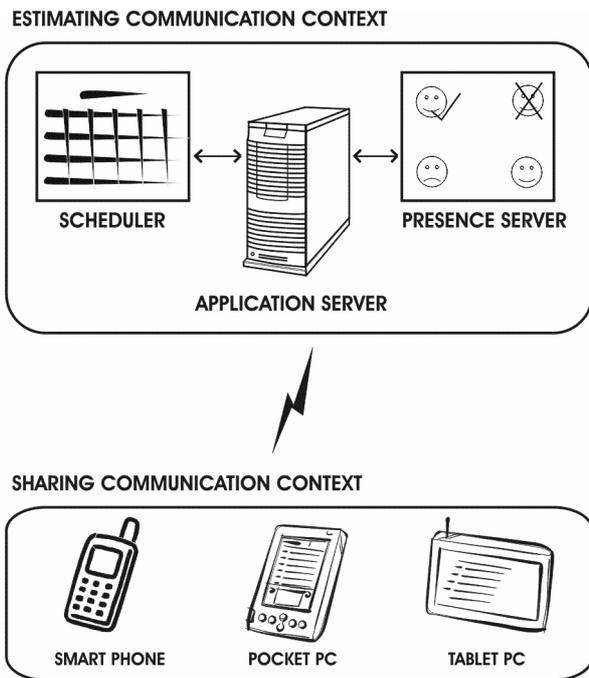


Figure 2. Simplified system configuration

Knowing information about current status and appointment's of the potential contact enables system users to select the timing and media of communication.

To assure up-to-date availability informations it is necessary for system users to maintain their own availability data either thru manual updating other thru system's automatic location detection.

4 DISCUSSION AND CONCLUSION

This paper has highlighted the importance of the informal personal communication by on-site problem solving process. Presented are important aspects which need to be considered when designing support for mobile knowledge sharing on construction site.

As a part of ongoing research within experimental project E-Site a pragmatic human-oriented approach for initiating communication in on-site problem solving process is presented. Our further challenge is to actualize the discussed approach and apply it to a present on-site process with our partners from the construction industry. Implementation of a prototype will then serve for improving existing project organizational structures.

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