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Abstract

The rapid development of wireless communication and mobile devices has created a great opportunity to support mobile group coordination at a more efficient level than before. This article presents a framework for Mobile Group Support Systems (MGSS) that considers four dimensions: supporting whom, supporting what, where to support and how to support. A good MGSS design should take consideration with the characteristics of each dimension: the system should be able to support mobile users working jointly with members from multiple parties; using available and advanced mobile technology, the system should be able to support context freedom, context dependent, and ad hoc coordination under dynamic, uncertain, frequent disrupting, time and space stretched and fluid context. To meet these requirements, we discuss the issues related to three basic functions of MGSS: mobile communication, group coordination, and context awareness.

Keywords: Group support systems, group coordination, context-awareness, mobile worker

1 Introduction

The rapid development of wireless communication and mobile devices has promoted rapid growth of mobile information services for consumers as well as mobile workers (Yuan and Zhang, 2003; Yuan et al. 2010). Since mobile devices are carried by individuals, most studies focus on the services provided to individual consumers such as mobile communication, mobile banking, mobile entertainment or to individual mobile workers such as mobile sales force automation, transportation and delivery services. Depending to the nature of the tasks, mobile workers may work independently or collaboratively. However, there is lack of systematic study on how mobile technology can be used to support coordination among mobile workers. Mobile Group Support System (MGSS) is a system using information technology to support mobile group coordination in a dynamic environment. One good example of MGSS is to support mobile group coordination in emergency response, which requires close coordination among groups of mobile workers including firefighters, ambulance teams, and police force (Yuan and Detlor 2005). MGSS is different from individual mobile work support because it provides a new dimension of group collaboration, in which members are required to communicate and coordinate their activities in order to accomplish interrelated tasks jointly. MGSS is also different from traditional Group Decision Support Systems (GDSS) and Distributed Group Support Systems (DGSS). GDSS was originally defined as a system that combines communication, computer, and decision technologies to support problem formulation and solution in group meetings. A GDSS aims to improve the process of group decision making by removing common communication barriers, providing techniques for structuring decision analysis, and systematically directing the pattern, timing, or content of discussion (DeSanctis and Gallupe 1987). In GDSS, the main focus is on

group decision making but not on implementation. In MGSS the main focus is to support multiparty coordination where coordination is defined as managing dependencies between activities (Malone and Crowston, 1994). In other words, MGSS is more action oriented although it may also involve group decision making.

The concept of distributed group support systems (DGSS) is using the combination of GDSS and computer mediated communication systems (CMCS) to facilitate group decision support for participants in different locations (Turoff et al. 1993). In DGSS, the main focus is on geographically distributed group decision making or collaboration through fixed-line communication networks. The DGSS is used to overcome time and space distances but not in the mobile environment. MGSS, on the other hand, need mobile technology to support group collaboration from time to time while moving from place to place.

Although there are some studies on mobile collaboration, mobile groupware, mobile computer supported coordination work (CSCW) (Luff and Heath 1998; Schrott and Glücker 2004; Messeguer et al. 2008; Pinelle and Gutwin 2005) and some prototypes such as MOST (Cheverst et al. 1999), UbiCollab (Divitini et al. 2004), MOCET (Ochoa et al. 2007) have been proposed, there is still lack of theories in the literature to fully analyze the nature and the requirements of mobile group support systems.

To fill up the gap in MGSS research, this study aims to provide a theoretical framework that provides better understanding on the nature and requirement of MGSS thus it can be used to guide the design of an effective MGSS. The rest of this paper is organized as following: in section 2, we present the proposed conceptual framework; from section 3 to section 6, we discuss the four dimensions of the framework in detail; in section 7, we outline the main functions that an MGSS should support and conclude our discussion in section 8.

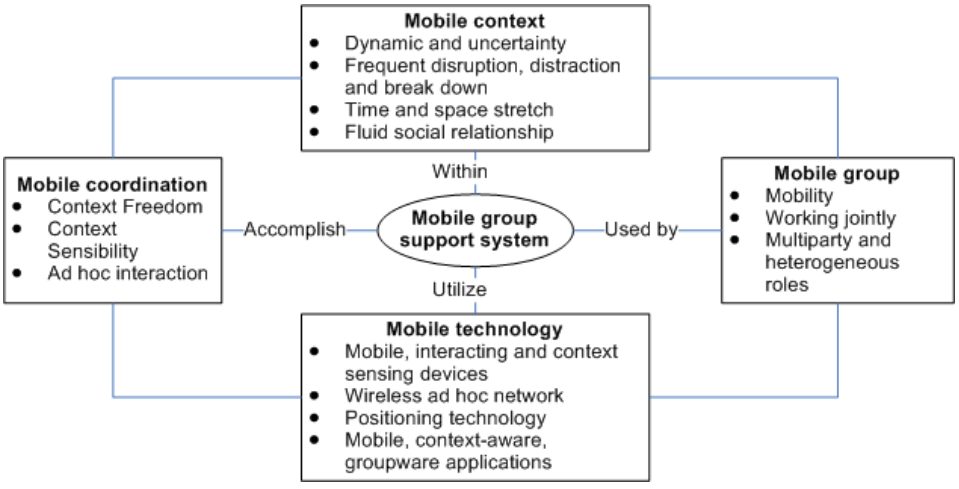

Figure 1. Conceptual Framework for Mobile Group Support Systems

2 The MGSS Conceptual Framework

To make better understanding on mobile group support, we may ask several important questions: How is a mobile group different from other groups or individual mobile workers? What is the context of mobile group work? What is the nature of tasks performed by mobile groups? What are the information technologies available to support mobile group work? To answer these questions, we

extend Zheng and Yuan (2007)'s model of individual mobile work support to formulate a conceptual framework of mobile group support. As shown in Figure 1, our model has four dimensions of MGSS: whom to support (mobile group), what to support (mobile coordination), where to support (mobile context) and how to support (mobile technology). An effective and efficient MGSS should fit with the characteristics of the four dimensions of support. To understand the four dimensions, we also need to analyze their relationships because they may have different impact on each other. Although we used the same four dementions (support whom, support what, where to support and how to support) from the model of Zheng and Yuan (2007), our analysis is tailored to the settings of mobile group support rather than individual support. The model is conceptually developed and justified based on extensive literature review.

3 Mobile Group

A mobile group refers to work teams in which at least some members need to move around with the support of mobile technology to accomplish their cooperative work. This definition demonstrates that we not only study the movement of group members, but also study how mobile technology changes the way people interact with others. Mobile groups are highly varied in different mobility types (Luff and Heath 1998; Kakihara and Sørensen 2002) and patterns of collaboration among group members (Pinelle and Gutwin 2005). Understanding these varieties helps us to make a better fit between the mobile group support system and the mobile group users. We further analyze the characteristics of mobile groups.

3.1 Mobility

Mobility cannot be avoided for some members of some working groups because of their task requirements. Some tasks usually need to be accomplished on sites away from an office within a specific timeframe. Mobility makes group coordination difficult because group members may move around anytime and anywhere and it is critical for them to know where they are and what they are doing.

Luff and Heath (1998) classify mobility into micro mobility (with in a building), local mobility (within a city) and remote mobility (out of a city or country) according to the geographic scope of their movement. Kristoffersent and Ljungberg (1998) propose three typical mobile modalities based on the purpose of the movement: wandering, traveling and visiting. We classify mobile groups into two categories in accordance with mobility patterns. One category is local wandering group, of which members moving around locally, such as construct teams for building a bridge, dock operation teams (loading coordinators, crane operators, forklift operators, and truck drivers) in a port, and medical groups (doctors, nurses) in a hospital. The another category is remote traveling or visiting group, of which some members travelling from one place to another, or visiting a remote place and spending time there before moving to another place. Good examples could be international rescue teams and FBI special agents.

3.2 Working Jointly

Mobile groups are different from individual mobile workers in the way that group members need to coordinate their actions because their tasks are interdependent. For example, rescue operation in the event of an earthquake may require close collaboration among victim searching personnel, digging machine operators, life support providers, medical professional and others. This additional work of alignment is referred as articulation work (Strauss, 1993), or coordination activity (Malone and Crowston 1990).

Pinelle and Gutwin (2005) suggest that different patterns of collaboration place different demands for support technologies. Mobile group members can interact either synchronously (both co-presently and virtual presently) or asynchronously. Moreover, the interacting structure of a mobile group can be centralized or decentralized. In a centralized structure, information, resources, and allocating power are controlled by an authority center; whereas in a decentralized structure, they are distributed among group members. According to the above two interaction dimensions (synchronicity and structure), Kristoffersen et al. (1998) classify mobile groups into four kinds: satellite group (such as logistics staff in which there is a centralized authority and can interact synchronously, both co-presently and virtual presently), fighter pilot group (such as couriers in which members interact with authority center asynchronously), cyber group (such as consultants, or emergency respond teams in which there is no authority and interaction is synchronous), and loose networking group (such as salesman, home-care treatment team in which interaction are both decentralized and asynchronous).

3.3 Multiple Parties and Heterogeneous Roles

A mobile group may consist of members from a single organization or different authorities. Each of them may play different roles and implement particular tasks with different background for the purpose of accomplishing a common goal. For instance, to handle a traffic accident a temporary group need to be organized that involves policemen, medical ambulance service teams, towing truck drivers, firefighters etc. They may specialize in different fields, come from different geographical locations, operate in different time windows, and may equipped with different mobile devices and using different mobile communication channels. It therefore will be a challenge to provide a support for multi-parties and multi-roles.

4 Mobile Context

Context refers to the various situational features that may influence the occurrence and the characteristics of the work performed (Johns 2006). Such features may include the physical settings of the work, interpersonal relationships, and the social environment. Tamminen et al. (2004) identify five characteristics of mobile context. However, their focus is on people's everyday mobile activities, not on mobile groups' collaborative work. We identify some important characteristics of mobile context that will most likely influence mobile groups.

4.1 Dynamicity and Uncertainty

Dynamicity refers to the nature of mobile context changing constantly, whereas uncertainty suggests that information required for the completion of work in question is often incomplete. These two characteristics are related to each other. Context changes when group members move from one place to another. This implies the need for situational flexibility—that is, functionalities of a mobile group support system should be adaptive to changing environment. Rapid and continuous changes cause information of different context to become inaccurate, unavailable, or obsolete. In situations involving higher uncertainty, the requirement for group members' attention is higher and continuous awareness of the context is required. Mobile groups often work in emergent (or contingent) environment. Time tensions make environment more dynamic and uncertain. For example, when an earthquake takes place, the most important time of rescue is within the first 72 hours. However, rescue teams have little information about infrastructure damages, number of casualties, and where are the victims located. Thus, collecting and providing the disaster context and adapting to on site situation are very important for rescue team support.

4.2 Frequent Disruption, Distraction and Breakdowns

Random disruptions often occur when a colleague's request for help may interrupt one's planned activity. Multitasking of mobile work also takes people's attention away from the focal task (Tamminen et al. 2004). Interruption happens constantly due to information requests and unexpected events. Roaming across areas of different network infrastructure can result in fluctuating service quality and thus often cause disruption in communication (Cheverst, 1999). All these internal or external interruptions may cause coordination breakdowns, which have the consequences of delays of work, waste of resources, intra-group tensions and conflicts. Coordination breakdowns often trigger for renegotiation, rescheduling and reconfiguration of people and resource (Ren et al. 2008).

4.3 Time-Space Stretch and Decentralization

The introduction of modern technology transforms the temporal and spatial aspects of the mobile context. Previously continuous geographical locations are fragmented into a series of fleeting places and thus the traditional concepts of spatial proximity are transformed from co-present to virtual present. The subjective experience of time is speeding up, intensifying, or becoming instantaneous (Townsend 2001). Lee and Liebenau (2000) identify six temporal changes brought by mobility: sequence, cycle, duration, deadline, temporal location and rhythm. For example, time is dissolved into a series of pieces of shorter duration. Thus, activities become fragmentized into a series of fleeting encounters and small pieces ad-hoc events both spatially and temporally. These changes have been called as time-space convergence or stretch, which describes the processes by which societies are stretched over shorter (shrinking) or longer spans of time and space (Giddens 1990). The stretch also brings social and cultural changes such as decentralization in social relationships.

The decentralization and fragmentation prompts people organizing their activities around flexible compartments of time, rather than associated with particular locations. On base of fragmentation, the mobile technology also introduces new continuities across space and time, previously disjoined through centralization (Green 2002).

4.4 Fluid Social Relationships

In the highly mobilized environment, not only space, time and context but also social relationships are reconfigured. As Kakihara and Sørensen (2002) suggest, mobility cannot be understood simply as corporeal movement, but more importantly as ways in which people interact with others. They argue that modern mobile technology make interactions highly mobilized and thus create a fluid topology, different from region and network topology, among people, objects and information in which interactions are dynamically reshaped and there are no centers, no boundaries and no relative distances mark the difference between one and another.

In the environment whereby people are always available by using mobile device, fluid interactions make social relationship dynamically reshaped and reconfigured significantly freed from spatial, temporal and contextual constraints. For example, experts can be easily reached through mobile communication for consulting during the work although they may be far away from the scene.

5 Mobile Coordination

There are different kinds of work in a mobile group: 1) individual work that is independent of others; 2) work that does not require ongoing interaction but needs the awareness of others' activities; 3) work that requires tight and real-time interaction with others; and 4) activities that articulate or coordinate others' work. (Pinelle and Gutwin 2005). An MGSS focuses on the support of mobile coordination activities. Coordination is the "act of managing interdependencies between activities

performed to achieve a goal" (Malone and Crowston 1990). Mobile coordination is the interactive activities of configuring people, resources, information/knowledge or places at a certain time in a fluid environment. There are main differences between mobile coordination and stationary coordination.

5.1 Context freedom for coordination in a virtual space

The intense use of mobile information technology enables people to organize activities independent from spatial, temporal, and contextual constraints. First, spatial mobility allows group members to coordinate from dispersed geographic locations and extends from co-presence to virtual presence. Second, temporal mobility make cooperative events freed from limitation of sequence, cycle, duration, deadline, and temporal location and rhythm (Green 2002). Third, mobility enables people to interact freely with others without same cultural background, shared situation or mood in a weakly tied social network (Kakihara and Sørensen 2002).

Coordination flexibility is prompted because cooperative activities are lifted from real spatiality, ordinary linear sequence of time and actual context (Green 2002). The context freedom is especially useful for a virtual group working together to overcome time and space limitations. For instance, a team project can keep going and group decisions can still be made when team members such as managers or engineers are travelling over different region. It is especially suitable for a group of mobile knowledge workers.

5.2 Context dependency for coordination in a physical space

However, above thoughts ignore the phenomenon of context dependency of mobile coordination for field workers. In many cases, availability of ongoing information about members' location, time and other context is critical for effective mobile coordination.

For mobile field work coordination, it is always important that people and resources configured, activities take place at right place, at right time. While on the move, mobile group members will likely experience unfamiliar and constantly changing contexts. To coordination with others, mobile actors need to pay close attention and constantly monitor locations to select shortest routes, check timetables, inform related persons, and anticipate context changes. Knowing the trajectory (locations over time) and the context of actors and resources is critical for organizing them "at right place, at right time". For example, in a tourist group, a tourist guider needs to be aware of local situation changes in order to make arrangement adjustment for transportation, meal, sightseeing, entertainment, shopping etc. She also needs to take care of the tourists in her group, not only their wellbeing but also where they are to make sure not to be late or get lost. From other side, tourists often need to communicate with the tourist guider in order to check the schedule or ask helps. Travelling related context is critical for coordination between tourist guiders, service agencies and tourists. The context dependency of mobile coordination requires MGSS taking time, space and other context as important references.

5.3 Ad hoc coordination

The need for coordination is due to the changing of situation. If everything is as planned or expected, there is less need for coordination. Modern mobile technology makes interaction highly mobilized and fluid, which is extensively relying on ad hoc communication (Kakihara and Sørensen 2002). The term ad hoc signifies "for the purpose in hand rather than planned carefully in advance". In fluid environment, fragmented people, information and objects flows in fast and unpredictable shapes. Reconfiguring and reshape occurs frequently with regards to ongoing demands of the activity they engaged. In other words, configuration of people, resources and information is ad hoc and unstructured. Collaboration among unplanned encountered (both in physical and virtual space) co-workers are often opportunistic. So MGSS is required to deal with the ad hoc coordination in fluid environment.

6 Mobile Technology for Group Coordination

Mobile technologies are new resources for accomplishing various everyday activities that are carried out on the move (Tamminen et al. 2004). Technologies that can be used to support mobile group work may include: mobile devices, mobile network infrastructure, positioning technology, and related supporting tools.

6.1 Mobile devices

There are a variety of mobile devices available, such as cell phones, smart phones, PDAs and notebook computers etc. Mobile group members may use different mobile devices especially if they come from different regions or authorities. For instance, policemen and medical team members may use different devices. The interoperability therefore becomes a critical issue. Some basic functions such as voice communication, email, short message, and web access now are available for most mobile devices and people can communicate with each other. However, different mobile devices have different user interface, processing power and may use different operating systems so it may affect the implementation of more sophisticated mobile group support software. Standardization of the devices used by group members can be one but not the only solution to solve this problem.

6.2 Wireless network

The wireless networks face many challenges. There is no universal coverage and universal standards for wireless network connections. Network connectivity may affect the coordination between mobile group members when they travelling in different region. For instance, a tourist group may travel in different countries. For group members to communicate with each other, they must rely on the network locally or globally available.

For mobile collaborators moving across a wide area, fluctuations in bandwidth and signal strength, frequent failures, and blind spots may make connections unreliable when mobile collaborators move across a wide area (Zheng and Yuan, 2007). These problems make seamless coordination between remote mobile members difficult. Unreliability may cause periodic disconnections, loss of data, and long delays. An MGSS should have the capability of operating across heterogeneous unreliable networks (Cheverst et al. 1999).

6.3 Positioning or tracking technology

Positioning refers to the ability to locate the geographical position of a person. Since many mobile coordination activities rely on location-related information, positioning capability is very important for mobile group support. Global Positioning System (GPS), cell phone systems, Radio-frequency Identification (RFID) systems are available to determine the location and trajectory of a moving object. For mobile group support, it is important to positioning or tracking moving equipments such as vehicles as well as group members and sharing the location information with each other. GPS based navigation system is also very useful for mobile support.

6.4 Related Supporting Tools

MGSS can take advantage of three kinds of information systems: mobile work support systems, computer supported cooperative work (CSCW) groupware and context-aware computing. Mobile work support systems such as mobile workforce automation are mainly used for supporting individual mobile knowledge workers or field workers (Zheng and Yuan 2007; Yuan et al. 2010). With the addition of group communication and coordination components, they can be extended to support

group workers. Groupware refers to the programs that help people work together collectively while being located remotely from each other. Such system can be used to support joint project with the team members geographically distributed (Gutwin and Greenberg, 2002). Traditional CSCW groupware usually deal with stationary situations. With the use of mobile communication and context-awareness, they can also be extended to support mobile coordination (Tao and Qiang, 2010). Context-aware computing is defined as the use of context information to inform the computing device to provide service relevant to the current context (Burrell and Gay 2001). The term context is only related to the interaction between users and applications (Dey 2001), and is not related to interaction between the user and other group members. The design of an MGSS should take into consideration the gap between group awareness in CSCW and context awareness in current context-aware computing.

7 Basic Functions of MGSS

Traditional distributed group support systems (DGSS) mainly support decision making for tasks in planning phases. They focus on promoting information share and optimizing the resource or task allocation. These functions are appropriate for stationary group because the environment is relatively stable, activities are routine and could be pre-planned. However, due to the uncertainty and the dynamics of mobile group work processes, adjustment and re-arrangement occur frequently. A MGSS needs to emphasize on tasks execution phases. Here, we identify issues should be considered in three functions of an MGSS.

7.1 Mobile group communication and information exchange

The mobile connection and computer-mediated communication (CMC) of MGSS should adapt to the requirements of the four dimensions we mentioned above.

1) Beyond being there

CMC technologies such as video-conferencing, chat rooms, e-mail, bulletin board systems, are widely used in group support. Some scholars argued that CMC has some weaknesses comparing to face-to-face (FTF) communication, e.g. the lack of access to implicit cues, shared context, informal interactions, and spatiality of reference (Olson and Olson 2000). Some of the weaknesses are likely to be overcome through new technologies. For example, with the built-in video camera and audio/video communication, 3G smart phones such as iPhones, can significantly improve the media richness. Mobile CMC can be more effective than FTF communication, particularly when the collaboration is complex and sustained. Mobile CMC should go “beyond being there” by using advanced technology to help group members better engage with one another’s relevant knowledge, motivations, status assessments and trajectory of ongoing work, rather than merely take the advantage of FTF communication as goal (Carroll et al. 2009). Mobile CMC enables the virtual group meeting and group information exchange beyond the time and space limitation. Mobile CMC can also make more structured information exchange, automate documentation, and serve as a group knowledge sharing system (Liu and Li, 2011).

2) Connectivity is critical

Under highly uncertain and dynamic environments, frequent, timely, problem-solving communications are more effective (Gittell, 2002). Because disruptions and breakdowns occur frequently, connectivity becomes a critical problem for mobile group support. As a result, how to support moment-to-moment communication across different context is an important issue in MGSS studies.

There are at least two problems of connectivity. First, from a technical perspective, unreliability and incompatibility of diversified networks and devices makes the communicating connectivity problematic. Second, organizational and security problems may decrease connectivity of mobile

groups. For example, in the case of emergency, some firemen may need architecture and electricity system information of the building. They should know who should contact and how to contact before they can communicating with the right person.

There have been some proposals to solve connectivity problems. For instance, various group mobility models can be used to predict future connectivity (Wang and Li, 2002). Some problems may be avoided by design. For example, Pinelle and Gutwin (2005) proposed a system named Mohoc to avoid this problem by arranging the work patterns: autonomous members and clearly partitioned tasks, clear policies on who can access and modify data and artifacts, no constraints on timely updates, allow asynchronously communication and awareness. With the roles and authorities dynamically built into the group communication structure, MGSS can also make the information exchange targeted to the right parties or group members.

7.2 Resource allocation and tasks arrangement

In mobile group work, coordination is achieved through the right configuration of people, resources, knowledge, and places at a certain point of time (Bardram and Bossen, 2005). Mobile group needs not only resource and task allocation in planning phase, but also frequent reconfiguration of resources and people during the collaboration process.

1) Flexibility and adaptation

Both allocation and configuration need to be flexible and adaptive in the mobile context. This is because resources requirement is unforeseeable, plans may be disrupted frequently by unexpected events, and mobile members may drop in or out of collaboration processes, resources and people must be continuously re-allocated and reconfigured. Therefore, transitions between different configurations facilitate the flow of mobile collaboration. How to support the transitions between these configurations seamlessly is an important issue of MGSS design. For the case of landscape architects, Büscher et al. (2003) proposed a shared workspace prototype including software with different devices. The landscape architects need to move between these devices, thus the prototype should manage the transition of ongoing design and materials from one device to another smoothly.

2) Priority and feasibility

Traditional group support usually concentrates on optimization. For mobile groups, timeliness is critical, information is incomplete, and the engagement with diverse resources and tasks are more complex. For dynamic resource allocation and task arrangement, it is important to share resource availability and task requirements among group members at different levels. Optimization may not be as important as feasibility and prioritization for mobile group support. For example, for emergency response, resource and task allocation is difficult to be optimized due to great uncertainty, time urgency, and severe resource shortage. Rescue operation priority has to be set based on who can be found and reached first and which rescue process is feasible (Jiang et al., 2012).

7.3 Context Awareness

To meet the needs of mobile coordination, a MGSS groupware needs to be either aware of the dynamic context or capable of overcoming context constraints.

Awareness is an understanding of the activities of others, which provides a context for your own activities (Dourish and Bellotti, 1992). Awareness plays a core role in cooperative work. Through ‘awareness’, mobile workers can seamlessly align their dispersed but interdependent activities by taking heed of their joint effort and to adjust their own individual activities accordingly (Gutwin and Greenberg, 2002). But awareness can do much more than providing surround status information. It can enhance common ground of a group, support community of practices (to articulate roles and

responsibilities), establish social capital and promote human development (Carroll et al. 2009). As distraction and disruption occur more frequently, peripheral awareness is more important for mobile groups.

Here the term context refers to any information that can be used to characterize the situation of an entity (Dey 2001). Context plays an eminent role with mobility, as a reference of mobile coordination and a filter selecting the most appropriate service.

Many categories of context have been studied in previous research. In the case of MGSS, context awareness should include: group context, task context, resource context, mobility context, and coordinative activity context. Group context refers to cues related to group members such as their profiles, roles, social state, proximity and distance among each other, strength of social ties, social attractiveness, sociability features, etc. Task context refers to those cues identifying the situation of task being performed. For example, the rescue team should know the location, time of tasks and other physical situation required to perform the task such as the weather condition. In order to reconfigure resources, MGSS should sensor the resource context of the origin, place, control authority, and availability of resources such as whether the bridge has been damaged or not. Mobility context is also important to estimate group members' next actions for facilitating coordination. Mobility context may include entities' locations over time, duration-of-stay, and moving speed and directions. Coordinative activity context refer to the cues that may influence the coordination between activities such as sequence and pre-requisite constraints of activities, time criticality or duration of each activity, interaction of activities, progress stage of activities. The context of a mobile group work also includes a variety of elements and they are tightly intertwined with users' continuously changing internal and social interpretations. For system capability reasons, only the context factors related to specific tasks, which can be called as task-oriented context, need to be aware of in MGSS groupware.

Recently, there is growing number of researches focus on developing context-aware group support systems. For instance, Bilandzic et al. (2010) developed SociCare, a context-aware mobile community emergency system. Meyer et al. (2011) developed CoMa (Collaborative Map), a digital interactive map to support mobile collaboration in spatially distributed working groups. The system can support a wide range of applications where human resources have to be coordinated in a spatial context and tasks need to be assigned dynamically depending on capabilities and situation context. Luqman and Griss (2010) developed Overseer, an open multi-agent system that leverages context information in a mobile setting to facilitate collaboration and task allocation for disaster response.

8 Conclusion

In this paper, we proposed a conceptual framework for MGSS with four dimensions of support: mobile group, mobile context, mobile coordination and mobile technology. The four dimensions cannot be understood separately because they are highly intertwined. A good MGSS design should adapt to the characteristics of each dimension: the mobility, jointly working, multiple parties of mobile groups; dynamic, uncertainty, frequent breakdowns, time and space stretched, fluid social relationship of mobile context; context free, context dependent, ad hoc coordination; and current advancement of mobile technology. We also identified three coordinative functions that an MGSS needs to support: communication, resources and tasks allocation and configuration, and context-awareness. Our framework provides a good starting point for further research and development of mobile group support systems. For instance, we need to study how MGSS should be designed differently in order to support different types of mobile group users. We need to study how mobile context should be taken into consideration to facilitate mobile coordination. We need to study how MGSS will help to reshape the dynamics of the coordination relationships among group members. We need to study what mobile technology is useful and what is not in real application through case study and experimental design.

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