

Sense-Making and Mindfulness of Interdependencies in Virtual Organizations

Ban Al-Ani

David Redmiles

Andre Van der Hoek

Uni. of California, Irvine, Department of Informatics
Bren Hall, Irvine, CA 92697-3440 USA
[\[balanilredmilesandre\]@ics.uci.edu](mailto:{balanilredmilesandre}@ics.uci.edu)

ABSTRACT

We are interested in investigating a means to support distributed collaborations by raising awareness of interdependencies. Interdependencies can exist amongst organizational units, the team, the individuals, and the product both across sites and within a single site. We propose integrating a series of tools that we have developed based on the principles of the Continuous Coordination (CC) paradigm. We suggest that integrating these tools will increase distributed stakeholders' awareness and assist them in their sense-making and mindfulness processes. It can also lead to a better understanding of interdependencies and the impact of awareness on the distributed development process.

Author Keywords

Distributed development, coordination, awareness, mindfulness, sense-making, virtual organization.

ACM Classification Keywords

H.4.3 [Information Systems Applications]: Office Automation-Groupware; H5.3 [Information Interfaces and Presentation] Group and Organization Interfaces – Computer Supported Cooperative Work.

INTRODUCTION

There exists a need for organizations to achieve a congruent state in which individuals make the “right coordination choices” that lead to an overall effective and efficient coordination effort [13] [2]. However, organizational literature suggests that coordination choices can only be determined right or wrong retrospectively. Typically individuals always appear to make the right choices when they are making them, within the context of current awareness. Their current state may not include an awareness of the diverse ways in which processes and

events are interrelated, disregarding warning signals when taking a coordination action [15] [16]. It is only afterwards that they realize the signals were symptoms of a problem that led to a negative outcome. They may only then realize that their awareness did not lead to an efficient and/or effective coordination effort. Thus, sense-making and mindfulness processes are important aspects of any efficient and effective coordination effort.

Weick et al [16] state that organizational sense-making is first and foremost about the question: How does something come to be an event for stakeholders? They state that an event is “talked into existence”, suggesting an event does not exist unless stakeholders are aware it exists and discuss it. They also define sense-making as an ongoing activity in which stakeholders rely on their awareness to determine what is happening and what needs to be done.

Mindfulness can be considered as the interrelations among the processes of perception and cognition. It can lead to a rich awareness and thus a capacity for action [15]. However, when information is distributed individual awareness can be based on an individual's interpretations of the information at hand. Their interpretations may not be shared by others in the virtual team or the organization and thus it may be faulty. These factors and others make coordination across sites more difficult [7].

The need for coordination typically arises from inter-site and cross-site interdependencies of tasks, processes, stakeholders, etc. Coordinating these interdependencies and maintaining stakeholder awareness is an ongoing challenge that is yet to be fully overcome. Conversely, attempts to remove dependencies and isolation can lead to other challenges in addition to removing the reason for distributed development – taking advantage of distant expertise among other benefits [8] [10].

Previously, we developed a series of coordination tools that provide alternative means of communication and visually identifying dependencies amongst stakeholders, thus increasing awareness [12]. We are currently working on extending these tools to allow developers to make more informed decisions of when and how to act. We plan on initially extending CC tools such that a tool not only visualizes dependencies among stakeholders of a single project, for example, but also identifies their dependencies

within and across sites (e.g. processes, organizational changes...etc). Thus we aim to support the sense-making processes and mindfulness of distributed team members in a virtual organization.

The following section presents a review of related work. It is followed by a discussion of our research questions and proposal of an approach to find answers to these questions. Finally, the paper ends with the concluding remarks section.

RELATED WORK

A core concept to any cooperative work is the notion of interdependence [14]. Researchers have investigated and contributed to the solution of problems that arise as a result of different kinds of interdependence. These could include the interdependencies amongst artifacts, developers, tasks and resources, amongst others.

The interdependence of artifacts produced by a development team, for example, was investigated by de Souza et al [4]. They concluded that these tools typically impose a distinction between private and public aspects of developer's work. Consequently, they found that tools, such as configuration management tools, isolate developers from the effects of each other's work.

The interdependence of artifacts can also lead to interdependence amongst the developers associated to these artifacts; as can the structure of the development process [5] [2]. This interdependence includes *prerequisite dependencies* between suppliers and users. Furthermore, interdependencies can also arise amongst tasks and resources, such as shared databases [3]. These dependencies and others are summarized together with the processes that have been adopted to manage them [11].

Interdependence is typically not contained within geographical boundaries but can extend beyond a single site and can be detected across sites in virtual organizations. One possible negative impact interdependencies can have is on the development life cycle and may also lead to delays distributed teams [9].

Researchers have worked towards developing a technique to measure task dependencies among people, and the "fit" between task dependencies and the coordination activities performed by individuals [2]. Their findings confirm that congruence helps reduce the amount of time required to perform tasks.

Others have found that carrying out changes in an organization, without considering interdependencies, like developers being re-assigned or leaving the organization can have negative impact on the performance of a team. It was found that these changes can also potentially lead to delays, uninteresting notifications, notifications overflow, missing notifications, and so on [6].

The importance of being aware of these interdependencies is central to making the right coordination decision. Coordination has been attributed different meanings.

Malone and Crowston for example, list several of these within different contexts, while proposing one to suit the findings that they report [11]. According to coordination theory, the activities in a process can be separated into those that are necessary to achieve the goal of the process (e.g., that directly contribute to the output of the process) and those that primarily manage various dependencies between activities and resources [3].

Coordination within the CC paradigm addresses the challenge in achieving an appropriate level of awareness to coordinate development and providing it at a time that is suitable to stakeholders [12]. Interestingly, other research has found that shared knowledge of the team was more important for members working across sites, whereas shared knowledge of the task was more important with members at a single site. The need to share information, what needs to be shared and the importance of each type of shared knowledge shifts depending on whether members were referring to collocated or distributed work [7].

This review of interdependencies and the negative impacts it can have on performance together with the rise of distributed development lead us to conclude that new ways of coordinating these interdependencies are needed.

DISCUSSION

The main purpose of coordination is often considered the management of dependencies [11]. However, a review of literature reveals that there are many different types of internal and external dependencies at both the team and organizational level both within sites and distributed geographically across sites.

Current approaches typically consider one type of dependency and thus do not necessarily provide the stakeholders with sufficient awareness to make the right coordination choices. Some researchers also prescribe certain processes to address certain types of dependencies [e.g. 12].

Our exploration of existing literature combined with our own experience in the field lead us to two axioms. First, stakeholders need multi-level and cross-site awareness. Second, the repertoire of actions needed to achieve awareness and the coordination actions taken in response are indeterminable.

Coordination requires an awareness of the existence of interdependencies not only at the team level but also at an organizational level. We suggest that achieving this increases the proportion of awareness of weak signals of developing problems [15]. Moreover, we expect that achieving awareness will require stakeholders to filter information to assist them in their sense-making process. Our reflections led to our posing our first research question: *What do distributed stakeholders need to do to achieve awareness that enable them to make sense of dependencies that exist at a higher level?*

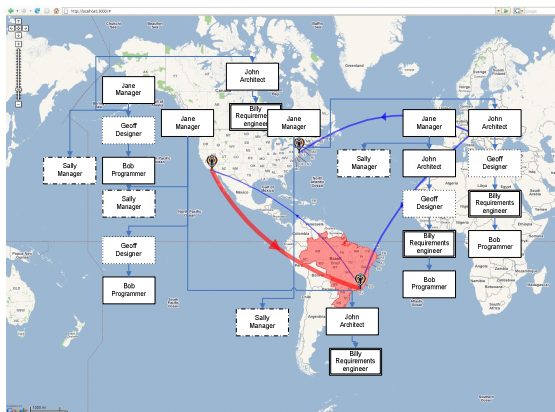


Figure 1.a. Social cross-site stakeholder dependencies

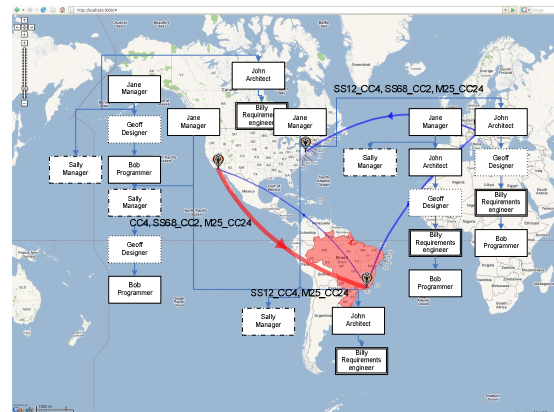


Figure 1.b. Task dependencies listed above links

Figure 1: World View (WV) visualization of team structure, availability, task and cross-site dependencies.

Coordination fluidity is also a necessity. It involves fluidity in both the information needed to achieve awareness and the fluidity in the appropriate coordination actions taken. Thus the actions taken to coordinate interdependence should not be prescribed but instead should consist of impermanent repertoires of actions [15]. This leads to our posing the second research question: *What do stakeholders need to be mindful of when deciding on a coordination action?*

The answers to these research questions will assist us in developing tools that will support coordination efforts across-sites and within sites.

OUR ANSWER TO THE QUESTION: WHAT NEXT?

We propose integrating the initial set of CC tools, starting with Ariadne and World View (WV), to extend their visualization of inter-dependencies. WV provides managers, team leaders and developers in general with a central repository that can derive, retain and visualize the structure of distributed teams, the availability of its members and their locality. Conversely, Ariadne is a visual collaborative software development tool that highlights the socio-technical relationships between source-code artifacts and the developers implementing those artifacts [1].

We plan on extending the inter-dependencies represented by WV in a manner that allows stakeholders to view them in conjunction with each other or a view of a desired combination of dependencies or one type of dependency alone.

Figure 1 presents two possible implementations of this vision. In Figure 1.a, WV is extended to allow stakeholders to view not only team structure across sites but also cross-site team dependencies based on information extracted from shared repositories. Whereas, Figure 1.b illustrates how task interdependencies can also be visualized to inform stakeholders the artifacts that are interdependent across sites. The tasks are listed above the link identifying

interdependence between team members located in different sites. Other dependencies can also be visualized, which also leads us to provide a means of filtering the layers of information that is visualized and a means to control the combinations dependencies that are viewed by stakeholders. These filters can help stakeholders avoid being overwhelmed by information while allowing them to explore which combinations assist in increasing their awareness.

Such visualizations will allow us to explore the impact of organizational interdependencies and can help answer our research questions. For example, what is the impact of transferring a team member from one site to another or from one team to another? What is the impact of a remote team member's or members' meeting face-to-face? How do stakeholders make sense of these interdependencies? We have some evidence that the first has a negative impact while the other leads to positive results. However, the impact it has on dependencies has not been investigated. These and many other questions can be investigated when several CC tools are integrated and implemented. The results of these findings will assist in furthering our understanding of dependencies that can exist between aspects within the organization, the team, the individuals, and the product.

CONCLUDING REMARKS

We are interested in investigating a means to support distributed collaborations. A core concept to any collaboration is the notion of interdependence. The main purpose of coordination is often considered the management of dependencies. There exist dependencies between the organization's coordination capabilities and stakeholders involved in product development.

In this paper, we present a perspective of dependencies and coordination within the larger context of the organization. We advocate stepping away from the narrow approach to

coordination, which focuses on task-resource, task-task, stakeholder-task, or stakeholder-stakeholder...etc dependency. We feel that this limited awareness can lead to stakeholders taking action without being fully aware of all the factors. Consequently, an intentional action may not lead to the intended result.

It may be impossible to make a stakeholder aware of all factors and predict all random events that can impact a coordination effort. However, it is possible to investigate what actions stakeholders need to take to gain a wider awareness of inter-site dependencies and cross-site dependencies. It can also be possible to develop support for these awareness seeking actions. The integration of the collection of CC tools can support distributed stakeholders' sense-making and mindfulness processes.

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