

UBIQUITOUS COLLABORATION: AN IT RESEARCH PARADIGM

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***ABSTRACT:** Global competition is stimulating an evolutionary merger of collaborative environments and ubiquitous computing making anywhere, anytime collaboration possible. Ubiquitous collaboration, a blending of collaborative environments and ubiquitous computing, is already influencing business behavior. The literature, however, does not fully appreciate its implications. The paper offers a perspective on ubiquitous collaboration and explores the existence of a new research paradigm. Unique aspects of this new paradigm can challenge current research methods and motivate the need for investigating new constructs.*

INTRODUCTION

It is late in the evening and Laura, a director at a small manufacturing firm and a team member on a major multi-organizational project has just finished analyzing the latest technical changes to her team's product. As she logs-off her remote session with her company's computer aided design (CAD) server, she contemplates the option of notifying her teammates of her results by posting an update in the team's online project management folder or by sending a team-wide email. She quickly recalls the difficulty she recently experienced in attempting to download files from her laptop to the online folder that resides in a database belonging to her company's strategic partner. She further realizes that connecting to her email account may not be reliable because she is traveling in a taxi cab in the middle of town. She quickly pulls out her quad-band cell phone and makes an international call to Dan, lead technician at a foreign division of her company and team leader for the project. She briefs Dan on her results and sends him an electronic spreadsheet from the web function on her cell phone. Dan approves her results and offers to post her information from his desktop when he gets home.

Although the proceeding story is fictitious, it is potentially a real situation facing professionals in today's environment. Global competitive pressures are fueling the need for multi-organizational collaboration and creating a demand for more capable and mobile means of communicating and processing data (Boudreau, Loch, Robey, and Straud, 1998; Chen and Nath, 2005; Fontaine, Parise, and Miller, 2004). The response to the demand has led to the formation of a multitude of virtual business environments involving all members of the value chain.

Until recently, the organizational expansion into collaborative environments (CE) has been subjected to the limitations of stationary computing, processing capability that resides in one organization or the other. Not surprisingly, early IT research has focused on the issues occurring within static brick-and-mortar organizations and their IT systems. For instance, Jarvenpaa and Leidner (1999) performed an impeccable empirical study on building trustworthiness in virtual teams, but assumed that participants only relied on a

single in-house IT resource. Perhaps a simplification of the settings may have been relevant back then; however, today's situation is dramatically different with the proliferation of ubiquitous computing devices, technologies like personal digital assistants (PDA) that can harness the power of information anytime and anywhere (Lyytinen and Yoo, 2002).

The potential benefits of ubiquitous computing are enormous. However, there are just as many issues to address. From a research perspective, ubiquitous computing in the context of collaborative environments can create the opportunity for many new cause-and-effect relationships and can even undermine the basic assumptions of earlier studies. Moreover, ubiquitous computing is a departure from the established experimental setting, the organization, and, therefore, can create many new extraneous cultural and personal concerns.

The primary intent of this paper is to explore how IT research is affected by the convergence of ubiquitous computing and collaborative environments aptly named ubiquitous collaboration. The significance of such an investigation is timely and is important to both business and research in general. Although it is tempting to address all possible issues, the specific focus of this paper is limited to how ubiquitous collaboration can impact IT research. To accomplish its objectives, this paper begins with a brief review of scientific research. Next, a discussion of existing studies on collaborative environments (CE) is made followed by a discussion of ubiquitous computing. Drawing upon the literature on CE and ubiquitous computing, key issues are identified. These issues are then analyzed with respect to the hallmarks of scientific research. Conclusions and recommendations are made based on the results of the analysis.

ASPECTS OF SCIENTIFIC RESEARCH

Information technology research is primarily conducted in the framework of scientific inquiry. Studies published in professional journals during the turn of the century support this assertion as evidenced by the increasing desire for research rigor (Palvia, Leary, Mao, Midha, Pinjani, and Salam, 2004). Their analysis showed that between 1998 and 2003, there was an increasing use of survey, mathematical models, and laboratory experiments. The use of laboratory experiments alone doubled during the period (p. 532).

Given the reliance on scientific research, it is important to understand the subtle aspects of science. After noting the wide-spread disagreement on the definition of science, Remenyi and Williams (1995) deferred to a definition offered by Einstein who describes science as a means of organizing chaos into logical system of thought in manner that is unique and convincing. Scientific research is a form of research that "focuses on solving problems and pursues a step-by-step logical, organized, and rigorous method to identify the problems, gather data, analyze them, and draw valid conclusions" (Sekaran, 2003, p. 21). As opposed to other more subjective forms of research like content analysis, scientific research is highly regarded for its objectivity resulting in increased confidence and greater acceptance of research results.

A subtle aspect of the scientific method is the interpretation of paradigm shifts. Kuhn, the acknowledged father of the scientific revolution, describes science as a construct that changes with its environment. Stated differently, science is not a static complex concept, but rather one that evolves with the needs of the members of a particular time period. Thus, it might be reasonable to postulate that in the continuously evolving environment of collaboration, fundamental paradigm shifts in IT research may result. As, Mumford (2003) states "it is important that IS scholars are aware that scientific principles are not always static and immutable and that ideas, explanations, and values can change as knowledge increases or attitudes change" (p. 198).

Sekaran (2003) identifies eight distinguishing characteristics of scientific research. These characteristics include purposiveness, rigor, testability, replicability, precision, objectivity, generalizability, and parsimony. Rigor, precision, and generalizability are of particular interest to this paper. Rigor concerns

itself with the degree of care exercised in the research. Precision refers to the accuracy of the findings. Generalizability refers to the scope of applicability of the findings. These three characteristics are of importance because their integrity is profoundly challenged in the study of ubiquitous collaboration as described in the body of this paper.

COLLABRATIVE ENVIRONMENTS

The concept of collaborative environments (CE) has been around for decades. In its earliest and simplest form, CE involved the exchange of email between departments or divisions within an organization. More capable networks and processors helped expand its application to include external organizations and other members of the value chain. Today, thanks in part to the affordability and proliferation of the Internet, there are products like Sametime and NetMeeting that facilitate collaboration at the extended network level (Fontaine et al., 2004).

Earlier studies investigated both the technical and social aspects of CE. Technical studies addressed primarily the heterogeneous and distributed aspects of computing. These studies included investigations of interoperability amongst different hardware platforms and operating systems as well as database structures and data semantics (March et al., 2000). Many of the technical research efforts resulted in the establishment of standards like the Global Schema Approach and Electronic Data Interface (EDI). Ultimately, the resolution of many of the technical issues allowed businesses to form various types of relationships including the virtual organization (VO), supply chain management (SCM) and customer relationship management (CRM) and more recently electronic commerce relationships like business to business (B2B) and business to customer (B2C). Many social investigations stemming from these relationships have focused on the issue of trust and its effect on efficiency and effectiveness (Gallivan, 1999; Grossman, September, 2004; Jarvenpaa et al., 1999; Kasper-Fuehrer and Ashkanasy, 2001). Other social topics investigated include workflow (Hughes, O'Brien, Randall, Rouncefield, and Tolmie, 2001), cross-cultural barriers (Grossman, September, 2004; Jarvenpaa et al., 1999) and control (Vickery, Clark and Carlson, 1999) at the individual, group, and organizational levels.

UBIQUITOUS COMPUTING

Weiser (as cited in Chen et al., 2005) describes the ubiquitous computing phenomenon as “seamlessly integrating computers into the world in which we live in” (p. 57). Essentially, ubiquitous computing is a collection of dissimilar and dispersed computing and communication technologies that support the transparent integration of information exchange for mobile users and their organizations. It is a concept that the literature commonly refers to as anytime, anywhere computing and connectivity (Andersson and Lindgren, 2005; Chen et al., 2005; Lyytinen et al., 2002; March et al., 2000). Some of the technologies associated with ubiquitous computing include mobile communicators like Blackberrys and personal digital assistants (PDA) and various protocols and services like wireless application protocol (WAP), voice-over IP (VoIP), and virtual private networks (VPN). These services provide a broad range of digital capability across various physical and wireless media (Lyytinen et al., 2002).

Research on ubiquitous computing has primarily focused on technology. Many of the technical issues facing ubiquitous computing concerned themselves with operation in a heterogeneous and distributed computing environment. For instance, a transaction such as an inquiry from a cell phone for an airline flight can involve the systems of the cell phone service provider, the local network of the airline and the specific database where the flight information resides. Furthermore, there are numerous protocols and routing services involved that provide the data transactions that are transparent to the user. In addition to architectural concerns, there are interoperability concerns like schema and data conflicts, issues common to stationary computing. March et al. (2000) identified a number of issues specific to ubiquitous computing including variable communication linking, dynamic resource allocation, and location

management. Researchers like Lyytinen et al. (2002) raise the concern to higher levels and address the impact of scale and infrastructure. Indeed, if ubiquitous computing is to thrive at the global level, a multitude of dispersed services must transparently interact without adversely affecting persistence and reliability (Lyytinen et al., 2004).

Although the literature mentions the potential organizational challenges of ubiquitous computing, there is regrettably little specific research addressing issues in collaborative environments. Fontaine et al. (2004) notes that many executives do not even have a plan for addressing the use of collaborative tools in their organization; instead, most superimpose the technology on their existing business processes. The unfortunate ramifications of this predicament are that ubiquitous computing may indeed have a profound affect on collaboration. As Avital (as cited in Lyytinen et al., 2004) notes “the increasing prevalence of ubiquitous computing is likely to play a significant part in helping to reshape workplace interaction...” (p. 709). Other researchers (Andersson et al., 2005; Chen et al., 2005; Lyytinen et al., 2002) have echoed the potential impact of ubiquitous computing as well.

UBIQUITOUS COLLABORATION

Ubiquitous collaboration, a reference used in this paper to denote the use of ubiquitous computing in collaborative environments, is a distinct subject. Presently, the literature discusses ubiquitous computing in reference to a single organization. Similarly, CE is discussed without specific reference to ubiquitous computing. Clearly, it stands to reason that issues relating to ubiquitous computing take on new dimensions in the context of collaborative environments involving multiple organizations culturally and temporally spread across the world.

Ubiquitous computing extends the boundaries of collaborative environments. One boundary is space (Andersson et al., 2005; Chen et al., 2005; Lyytinen et al., 2002). Because of the use of portable computing devices, there is no reliance on the physical structure of the organization. In fact, if outside service providers are utilized there is conceivably no need for a building. Another boundary is time (Andersson et al., 2005; Chen et al., 2005; Lyytinen et al., 2002). Ubiquitous devices are mobile; thus, from the organizational perspective, there is no need for offices to be open in order to conduct business. This decoupling from the office appears to create an impression that working hours are unrestrained. Finally, there is a third boundary, one that is only briefly mentioned in the literature (Lyytinen, 2004) but deserves attention none-the-less. That boundary is control. The proliferation of affordable mobile devices with multimedia capability places the flow of information primarily in within the control of the individual. In retrospect, a member of a ubiquitous collaborative environment has the perceived ability to be simultaneously anywhere and at anytime, a notion referred to in the literature as multi-presence (Lyytinen et al. 2004)

Ubiquitous computing can also place a huge demand on the infrastructure, services and culture of collaborating organizations. Lyytinen et al. (2002) described the infrastructure and services required to support ubiquitous computing as “technically heterogeneous, geographically dispersed, and institutionally complex without any centralized coordination mechanism” (p. 379). Indeed, just the addition to services alone requires new provisions to handle authentication, dynamic resource allocation, and customization. With respect to culture, Chen et al. (2005) described the organization as one that is flexible and reactive to the needs of mobile workers and is willing to adopt a value system that is in-line with the temporal and spatial realities of a ubiquitous environment. In short, Chen et al. outlined an organization that is far different from the traditional brick-and-mortar organization with its hierarchical organizational structure and processes.

In summary, there are many unique aspects to ubiquitous collaboration. As a subject within itself it is rich in research possibilities. There are opportunities to explore it from all levels: individual, group, and

organizational. Ubiquitous collaboration is also a dynamic net-work centric environment, whereby the organization is just another member in the network.

AN ANALYSIS OF THE ISSUES

Although several earlier organizational studies on CE allude to ubiquitous collaboration, the computing context from which their issues are eventually examined from is a stationary environment, one where the workforce of one organization interacts with that of another using each other’s respective organizational IT resources (Boudreau, Loch, Robey, and Straud, 1998; Jarvenpaa et al., 1999; Kasper-Fueher, Ashkanasy, 2001; Koh and Kim, 2003). Ubiquitous collaboration is sufficiently different from earlier forms of CE to warrant additional consideration. Moreover, a re-emphasis on ubiquitous collaboration may even challenge previous findings. As Avital et al. (as cited in Lyytinen et al., 2004) noted the ability to connect anytime and anywhere can revise the relationship of virtually mediated work.

An analysis of the literature indicated several broad areas where ubiquitous collaboration distinguishes itself from stationary CE. The first area is control (Lyytinen et al., 2004; Mumford, 2003). Figure 1 illustrates how the flow of information extends beyond the boundaries of the organization and potentially involves processes and systems that do not belong to the collaborating organizations nor are necessarily under their control. In fact, the organization is conceivably just another node in the network.

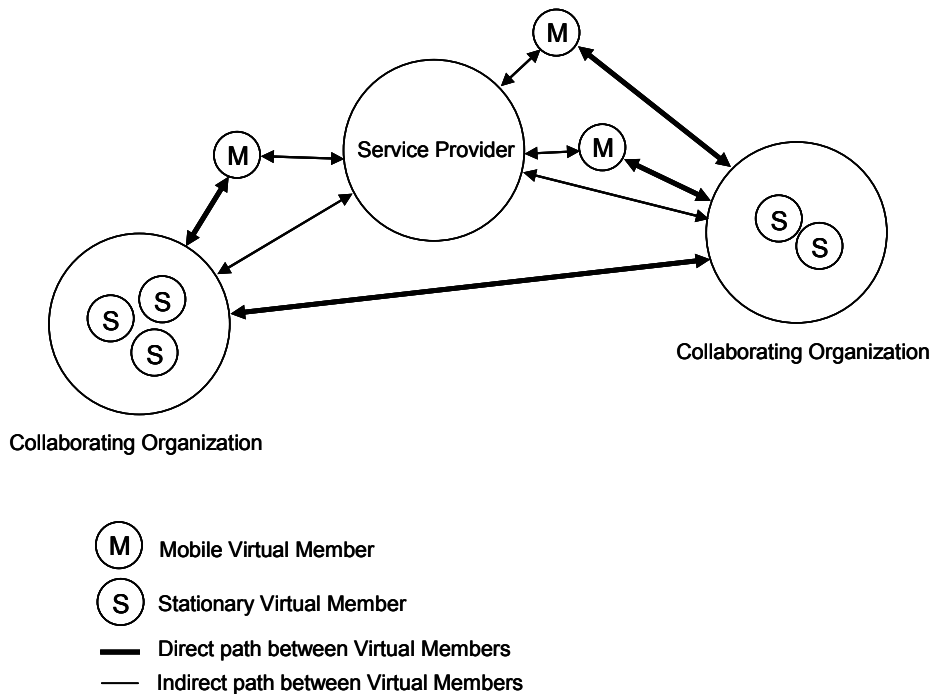


Figure 1. Flow of communication amongst members of ubiquitous collaboration.

Although earlier studies (Jarvenpaa et al., 1999; Vickery et al., 1999) have investigated control, it has typically been from the group and organizational level. There is now a need to investigate aspects of control from the individual level. Moreover, individuals can, at their discretion, access services through a number of different paths resulting in an amalgamation of old and new processes and in the formation of a dimension of work that has not been previously investigated. The story introduced at the beginning of

this paper illustrates how members of a collaborative effort might transact the same piece of knowledge in a number of different ways involving a number of different processes. Some studies even provide anecdotal evidence of this phenomenon. Nidamarthi, Allen, and Sriram (2001), for instance, observed that members of a collaborative design team utilized several Internet-based collaboration tools to supplement their traditional design process. In some situations, the team resorted to using the telephone. In many other situations, the team utilized email. In either case, the team did not rely solely on any one particular form of communication.

Related to the issue of control is supervision. Both Jessup et al. (2002) and Lyytinen et al. (2004) describe the issue of supervision in terms the organization versus the individual. On one side of the debate, organizations need to know that their resources are being used appropriately and effectively in accomplishing the task at hand and, thus, may resort to using automated tracking programs that provide digital traces of resource utilization. On the other side, employees may oppose the intrusion on what they believe to be their privacy. It is a delicate balancing act that is exasperated by the fact that in a ubiquitous collaboration, employees are not only virtual participants on teams, but may not even be present in a physical office. The matter is further complicated by the fact that the membership reports to different organizational hierarchies.

Another broad area of distinction is social boundaries (Chen et al., 2005; Jessup and Robey, 2002; Lyytinen et al., 2004; Lyytinen et al., 2002). Although the pervasive nature of ubiquitous collaboration affords more opportunities to conduct business, there is concern over work encroaching into the personal lives of the individuals. It is tempting for organizations to justify the convenience of remote employment and take advantage of the situation. In a global environment, organizations involved in collaborative efforts may demand schedules that span beyond the traditional work week. The boundary between work and personal life is a nebulous subject that has no precedence. There are many issues involved that touch upon ethics, values, and integrity.

AN ANALYSIS FROM A RESEARCH PERSPECTIVE

With respect to research, there is reason to believe that ubiquitous collaboration has the potential to change the paradigm. Ubiquitous collaboration can fundamentally alter work interactions, organizational processes and even business philosophy. Its complex nature and dynamics can raise questions with regard to how research should be conducted. For instance, scientific inquiry exercises rigor by controlling environmental conditions using popular methods like experiment research (Palvia et al., 2004). However, despite the benefits to precision and internal validity, there are downsides to external validity, specifically generalizability (Senakar, 2003). In other words, in a practical business setting with pervasive ubiquitous computing available, how relevant are studies that restrict a participant's options. As Mumford (2003) suggests, research needs to pay attention to who actually controls the technology. How would a member of a collaborative effort with the ability to decide on the method, place, and time of information exchange alter the findings of studies that have investigated the utilization of a particular IT resource?

Another concern for research is data collection. As Palvia et al. (2004) noted, there is a strong trend in the IS research community to conduct surveys. The concern here lies in the breath of the population surveyed and construction of the questionnaires. Global use of ubiquitous collaboration implies many cross-cultural issues that must be addressed both in the manner in which questions are posed (Mumford, 2003) and the population of interest (Senakar, 2003). Many of the constructs involving social boundaries and control have yet to be defined and it is possible that unproven measuring instruments do not measure the intended elements of complex dimensions.

RESEARCH CONSIDERATION

It should be noted that this paper recognizes the positive contribution of earlier studies on CE and does not argue against their merits. Rather, what this paper does propose is an appreciation of the pervasive ubiquitous computing environment which collaboration now operates under. In that regard, it is worthwhile to briefly examine some possibilities.

From the discussions presented in this paper, it was noted that control and social boundaries are areas unique to ubiquitous collaboration. Although empirical research on the constructs involved is still in its infancy, it is reasonable to assume that many variables will be derived from these areas that may influence previous and future investigations. These variables can either directly affect, moderate or modify findings. For example, the under-utilization of a Blackberry device may be caused by the imposition on personal time rather than a technical concern. Research will have to recognize that many new variables can come into consideration. Many of these variables may stem from studies from the individual's perspective; however, recognition should also be given to the global environment and its related cross-cultural issues. Factor analysis is appropriate technique to utilize in an analysis of these variables. Factor analysis, specifically cluster analysis, can help reduce the numerous variables into manageable dimensions for use in studies. For example, variables like user satisfaction, team cohesiveness, and convenience may relate to an overall utilization construct.

Another area to examine is research methodologies. Is relevance more important than rigor or is it the other way around? Methodologies that lead to greater relevance can compromise objectivity. The observational field study, for example, is a beneficial method of collecting pertinent information, but can be scrutinized for introducing bias (Senkaran, 2003). However, given the increasing complex dynamic environment of ubiquitous collaboration, it would appear difficult to maintain relevance by relying on artificial settings.

SUMMARY

This paper presented an exploration of ubiquitous collaboration and its implications on IT research. As the discussion indicates, there are issues relating to ubiquitous collaboration that are distinct from those of traditional collaborative environments that rely on stationary computing. Two broad areas rich in issues are control and social boundaries. Control concerns itself with the ability of the individual to decide the method, process, time, and place of communicating information. Related to the area of control is supervision, a subject that involves the issue of individual privacy and an organization's desire to understand the use and effectiveness of its resources. The area of social boundaries contains many ethical issues and well as issues involving values and integrity.

The pervasive nature of ubiquitous collaboration can have a significant impact on IT research. This paper identified examples of how ubiquitous collaboration can challenge the trade-off between internal validity and external validity. It also identified concerns over data collection specifically the cultural aspects of the population represented by the sample and the relevance of the variables being measured.

Several research possibilities were presented. One is to incorporate variables derived from the study of control and social boundaries. These variables can be applied directly to research questions or indirectly as moderators or mediator variables. Factor analysis maybe used to reduce these variables into meaningful constructs. Another research possibility is to re-examine the methodologies and consider ways of improving relevance.

Overall, ubiquitous collaboration is dynamic environment that has the potential to change not only business but research as well. It is a phenomenon that has extended into the global arena and has increased in scope. Addressing the concerns of ubiquitous collaboration is vital to its success.

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