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E-Collaboration: A Look at Past Research and Future Challenges

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ABSTRACT

The guest-editors of the first Special Issue on E-Collaboration provide an introduction to the issue. E-collaboration is broadly defined as collaboration among individuals engaged in a common task using electronic technologies. A brief history of the evolution of e-collaboration technologies is offered along with a discussion of research in the area. The paper concludes with a brief review of the contributions to the Special Issue and a look at one important future challenge for e-collaboration researchers, the challenge of theoretical summarization.

WHAT IS E-COLLABORATION?

Electronic collaboration (e-collaboration) is broadly defined here as collaboration among individuals engaged in a common task using electronic technologies. Examples of e-collaboration technologies are Web-based chat tools, Web-based asynchronous conferencing tools, e-mail, Internet-based listservs, collaborative writing tools, group decision support systems, and teleconferencing tools.

As far as we know, the term *e-collaboration* is being used for the first time to refer to an academic discipline in this Special Issue on E-Collaboration of the Journal of Systems and Information Technology. The term is being used here as an "umbrella" term that comprises several other fields, commonly known as computer-mediated communication, computer-supported cooperative work, groupware, group support systems, collaboration technologies, and, more recently, the so-called field of knowledge management.

A BRIEF HISTORY OF E-COLLABORATION TECHNOLOGIES

The first e-collaboration technologies can be traced back to the late 1960s, with the development of the ARPANET, the precursor of the Internet. The infrastructure for the development of e-collaboration technologies was available before that, since the early 1950s when the first commercial mainframes appeared, but at that time it was so costly to run mainframes that few considered the possibility of using them for anything other than complex calculations and centralized data processing. While that cost decreased over time, in 1966 it was still prohibitive, with the hourly cost of an IBM 7094 being as high as 45 times the minimum hourly wage (Kock, 1999).

The main motivation behind the ARPANET project, initially sponsored by the US Department of Defense, was the Cold War between the US and what was then the Soviet Union. The primary goal of the project was to build a dispersed and heterogeneous network of mainframes located in universities and research centers that could stand a nuclear attack, when the resources of one mainframe would be accessible from terminals connected to different mainframes in the network.

One of the earliest versions of e-mail was developed as part of the ARPANET project. At the time of its initial development, its developers did not see e-mail as much more than a "toy"

system that allowed them to interact electronically with their colleagues. In spite of this initial perception, e-mail use grew quickly as a tool to support collaboration between researchers, university professors and students, making e-mail one of the first successful e-collaboration technologies (Sproull and Kiesler, 1991). At the same time, pioneering implementations of e-collaboration technologies happened elsewhere in the US and Europe. This period was also marked by a phenomenal growth in the use of minicomputers, which were less powerful, stripped down, and cheaper versions of mainframes.

The mid and late 1970s saw the development of large-scale integrated circuits, whose transistor capacity was much higher than in normal integrated circuits, which in turn led to the development of smaller, more affordable, and more powerful computers, dubbed personal computers, or PCs. These PCs were later connected to each other through the development of the local area networks (LANs), which led to the development of many synchronous and asynchronous e-collaboration technologies in the 1980s. Some of these, such as Information Lens and The Coordinator, extended the basic features present in early e-mail systems. Other e-collaboration technologies provided support for decision-making meetings, such as GroupSystems, Teamfocus, and MeetingWorks. Still others, such as Lotus Notes and Domino, were suites on which customized e-collaboration systems could be developed to support group processes. Most of the e-collaboration technologies developed in this period resulted from the work of researchers in universities, government agencies, and corporate research centers.

The early 1990s saw the growth of the Internet, when research and development related to e-collaboration technologies extended beyond traditional research organizations and became a central business issue. The Internet began its exponential growth in 1993, when one of the first Web browsers, called Mosaic, was developed. This set the stage for the migration of collaboration systems from LANs to the Internet, mostly as client-server systems running on platforms made up of generic, platform-independent Web browsers (on the client side), and platform-dependent Web servers (on the server side). Today, the Web browser interface has become one of the most widely used interfaces for e-collaboration technologies.

RESEARCH ON E-COLLABORATION

E-collaboration research dates back to the 1970s, when Murray Turoff (1973; 1975) and Starr Roxanne Hiltz (1978) conducted their investigations based on the electronic information

exchange system (EIES), one of the first e-collaboration systems and the precursor of modern Web-based asynchronous conferencing systems (Turoff, 1978). This visionary work was followed by increasing interest in e-collaboration technologies, and the organization, by Paul Cashman and Irene Greif, of the first conference on e-collaboration in 1984, called computer-supported cooperative work (CSCW) conference, which has since become one of the key outlets for e-collaboration research focusing on technological issues (Bannon, 1993; Grudin, 1994).

A separate e-collaboration research tradition, focused on group decision support systems (GDSS), began in the late 1970s and early 1980s. By way of contrast with CSCW research, whose main motivation was to solve technological obstacles to e-collaboration, GDSS research emerged from the work of information systems researchers in business schools. Among the pioneers of GDSS research are Jay Nunamaker and Gerardine DeSanctis. Research on GDSS went on to become one of the dominant fields of research in information systems, focusing on the match between GDSS and group tasks, particularly same-time/same-room decision-making tasks. At the same time, CSCW research expanded its base, while at the same retaining its technological focus. Their different foci led to a dichotomy between GDSS and CSCW research that remains to this day.

While there have been many e-collaboration research initiatives around the world, notably in Europe and Japan (Grudin, 1994), the dominance of the US in the 1980s and early 1990s was particularly noticeable. This dominance is reflected in the disproportionate number of e-collaboration research publications authored by US researchers relative to the number of publications authored by researchers based in other countries.

Tim Berners-Lee's development of what later became known as the World-Wide-Web (or simply the Web), in 1989, led to a technological revolution that caught both CSCW and GDSS researchers largely by surprise. By the mid-1990s, many powerful and affordable e-collaboration tools and platforms became commercially available all over the world, which opened the door for a wide range of researchers from many countries to add to the body of e-collaboration research. Many of these researchers came from disciplines where research on e-collaboration was uncommon, such as accounting, medicine, organizational psychology, and marketing, to name only a few.

If we were to summarize the e-collaboration research tradition up to this date, it would be fair to say that it has been largely US-centered, fairly light on theory (in comparison to the

amount of empirical research generated), focused on either the solution of technological problems associated with e-collaboration (CSCW research) or the support of same-time/same-room e-collaboration (GDSS research), and centered on experimental research in controlled settings, mostly in the laboratory and, less frequently, in the field. Given the historical evolution of e-collaboration technologies, discussed in the previous section, this e-collaboration research tradition has recently led many to ask whether "traditional" e-collaboration research is really relevant from an international perspective and, perhaps more importantly, whether it is of any use to practitioners.

MAKING THIS SPECIAL ISSUE HAPPEN

We wanted to provide an outlet for contemporary e-collaboration research being conducted all over the world, and given the tradition of this area of research, it seemed advisable to find a "neutral" outlet. In recent years, the Australasian region has produced a large amount of high quality and "fresh" research in many areas, including that of e-collaboration. The fairly eclectic nature of the research coming from this region suggested that it could provide us with the right outlet for our Special Issue on E-Collaboration. We approached Craig Standing, the editor of one of the premier academic journals in the Australasian region, the *Journal of Systems and Information Technology*, who not only said "yes" but also embraced the project wholeheartedly from the outset. We thank him very much for that.

We invited papers on the design and implementation of e-collaboration technologies, assessment of the impact of e-collaboration technologies on organizations, and theoretical considerations on links between e-collaboration technologies and organizational outcomes.

We received 14 submissions, from which we were able to accept only 5 papers (a 35.7% acceptance rate). All papers underwent a rigorous review process. Two or three reviewers were assigned to each submitted paper. We would like to thank the following reviewers who so generously lent their time and expertise to this special issue: Raquel Benbunan-Fich, Kelly Burke, Janice Burn, Jerry Fjermestad, Kelly Hilmer, Anat Hovav, Ernest Jordan, Ron Kwok, Moez Limayem, Maris Martinsons, Sajda Qureshi, Anne Rutkowski, and Pak Yoong. Their reviews were considered by two of the guest editors and compared against the editors' own reading of the papers. The final decisions were then reached by consensus among all the guest editors and communicated to the authors.

THE PAPERS IN THIS SPECIAL ISSUE

The articles in this issue represent a variety of research traditions and highlight different aspects of e-collaboration research. But perhaps more importantly, the authorship base of this set of articles is truly international, representing a variety of countries. We have articles from authors based in the US, Brazil, UK, Italy, New Zealand and Canada. A brief summary of each article is provided below. The articles are ordered alphabetically by the first author's surname.

In the paper "**Do Media Really Affect Perceptions and Procedural Structuring Among Partially-distributed Groups?**" Kelly Burke and Kregg Aytes, from the US, highlight the importance of theory-based e-collaboration research that addresses longstanding research questions. They review several theories and derive related hypotheses addressing procedural structuring (e.g., setting agendas, using prescribed discussion and decision-making methodologies) in the context of e-collaboration. The study shows that preferences for procedural order affect structuring behaviors, but does not affect individual satisfaction with the group process. Also, contrary to expectations based on media richness theory, the study suggests that interaction media (video conferencing vs. audio conferencing) have no effect on an individual's perception of procedural structuring, or procedural structuring practices.

In the paper "**Facilitating Perception on Virtual Learningware Based Environments**" Hugo Fuks and Rodrigo Lemos de Assis, from Brazil, highlight the importance of studying distributed e-collaboration, particularly as it refers to distributed cognition, and provides a bridge between more traditional CSCW research and new forms of e-collaboration research enabled by Internet-based technologies. Their paper presents a conceptual model of perception in e-collaboration based on the related notions of communication, coordination and cooperation. The model is developed, tested and refined through experiments and action research studies centered on a learningware technology called AulaNet.

In the paper "**The Cost of Email Interruption**" Thomas Jackson, Ray Dawson, and Darren Wilson, from the UK, highlight the need for more research on e-mail, arguably the most ubiquitous e-collaboration tool in use today, particularly in "real world" organizational settings. The study focuses on the use of e-mail by employees in a business setting and shows that e-mail is more disruptive than generally believed. The study suggests that the "interrupt effect" of e-mail is comparable to that of a telephone call, and that the way the majority of users handle their incoming e-mail has been shown to cause far more interruption than expected.

In the paper "**E-Collaboration Tool for Technology Foresight Exercise**" Sanja Vranes, from Italy, highlights the importance of integrating different design paradigms in e-collaboration research. The study focuses on the analysis of a multi-paradigm software toolset consisting of several e-collaboration tools, including BATEV, DEBATER, and CyberDELPHI. It shows that the combination of multiple paradigms provides a firm foundation on which to address complex technology foresight problems more objectively.

In the paper "**The Emergence of a Theoretical Framework for GSS Facilitation: The Dualities of E-Facilitation**" Pak Yoong and Brent Gallupe, from New Zealand and Canada, respectively, highlight the need and importance of grounded theory development in e-collaboration research. They develop a new theoretical framework, called *The Dualities of E-Facilitation*, which emerged from an analysis of the e-facilitation behaviors of newly trained face-to-face electronic meeting facilitators. The goal of this theoretical framework is to help researchers and practitioners to understand the subtleties and difficulties in the application facilitation techniques in electronic meetings.

THE CHALLENGE OF THEORETICAL SUMMARIZATION

From the articles submitted to this issue, we are led to believe that several of the problems outlined earlier as part of our discussion of "traditional" e-collaboration research are, at least to some extent, "taking care of themselves". Of course, the self-centered nature of US research on e-collaboration still needs to be addressed, but the international authorship of this Special Issue suggests that this problem is not as bad as some may believe it is. The traditional and narrow focus of e-collaboration research on either the solution of technological problems associated with e-collaboration (CSCW research), or the support of same-time/same-room e-collaboration (GDSS research), seems slowly to be giving way to more eclectic research on e-collaboration. Furthermore, the over-reliance on experimental research also seems to be giving way to other forms of research that take into consideration "real world" factors, such as action research (Kock and Lau, 2001).

However, the fact that e-collaboration research is still light on theory in comparison with the amount of empirical research generated is problematic for at least a few reasons. Given the massive amount of empirical research on e-collaboration produced in the past 20 years and the still growing body of research in this area, one of the main challenges facing e-collaboration

researchers today is to make sense of the findings produced by all this empirical research. To face this challenge and succeed in pushing the boundaries of our knowledge regarding e-collaboration behavior, researchers need to be able to summarize large sets of related findings into theories or theoretical models. Nevertheless, theoretical research on e-collaboration has been very limited, in terms of both theory development and theory refinement. It is frequently the case that studies aimed at testing theories end with the conclusion that the theories are right or wrong, but fail to propose enhancements in the theories or suggestions on how to combine different theories to better explain e-collaboration behavior in its full complexity. Without robust theories of e-collaboration behavior, the most likely result is what one would call non-theoretical design, or perhaps more critically, "blind" or at least "myopic" design.

The 1970s and 1980s have seen the emergence of several theories developed largely to explain empirical findings of organizational communication research. Some of these theories were later used to explain e-collaboration behavior. As more empirical research was produced, now focused on e-collaboration technologies, other theories were developed, often to fill gaps left by earlier theories. This body of theories can be split into two main types, technological and social theories.

Technological theories of e-collaboration place particular emphasis on the fit between collaborative task and communication medium as a determinant of communication process and outcomes. That is, the foci of technological theories are the communication medium created by an e-collaboration technology and the group task being accomplished through the medium. Examples of technological theories are media richness theory (Daft and Lengel, 1986; Daft et al., 1987; Lengel and Daft, 1988), the gains and losses model (Alavi, 1994; Nunamaker et al., 1991), and the task/technology fit theory (Zigurs and Buckland, 1998).

Social theories of e-collaboration place particular emphasis on the role of the social environment and socially constructed information processing schemas in defining behavior toward e-collaboration technologies. Examples of social theories are the social influence model (Fulk et al., 1990), critical mass theory (Markus, 1990), adaptive structuration theory (DeSanctis and Poole, 1994; DeSanctis et al., 1993; Poole and DeSanctis, 1990), and the technology metastructuration model (Orlikowski et al., 1995).

The list of theories above is no doubt impressive and might suggest that, in a combined way, existing theories can be used to explain "everything" related to e-collaboration. Unfortunately,

this is far from the truth, for two main reasons. Firstly, with few exceptions (Trevino et al., 2000), the theories above have been proposed as alternative ways to explain e-collaboration behavior, and seldom combined to explain that behavior in its full complexity. This attests to the lack of maturity in theoretical work regarding e-collaboration behavior and is reflected in the theoretical "battles" between social theorists or technological theorists that became common in the 1990s (Kock, 2001). The second reason is a bit more interesting, or perhaps unexpected. None of the existing theories explores how our "nature", or the genetic makeup of our species, affects our behavior toward e-collaboration technologies. The relevance of studying the influence of our genetic makeup comes from evidence that human beings have been "engineered" by Darwinian evolution to communicate through the face-to-face medium, as this has been the main medium used for communication during the millions of years that led to the development of our present biological communication apparatus (Laitman, 1993; Wilson, 2000). Such a line of theoretical study has the potential to explain scientifically one key proposition of some technological theories that have been at the center of the arguments between proponents of technological and social theories - that we favor face-to-face, as well as face-to-face-like, communication media over other communication media - in a different and perhaps more integrative way than has been done before. By allowing for the isolation of innate from social (or learned) influences on e-collaboration behavior, this line of theoretical study may provide a long needed "missing piece" that will lead to the integration of technological and social theories.

Moreover, perhaps the realization that we are all large-brained primates using e-collaboration technologies (Kock, 2001) will not only allow us to make advances in our understanding of e-collaboration behavior, but will also give us (North Americans, Europeans, South Americans etc., alike) the humility needed to overcome the many paradigmatic obstacles (Kuhn, 1962) to theoretical progress that are inherent in being part of a human society.

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