ISSUES OF E-COLLABORATION AND TELECOMMUTING

Blaž Rodič[1]

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Abstract: *This paper examines the benefits and issues in using information technologies, to support collaboration of teams in a virtual environment, the emerging methods and technologies and socio-technical issues associated with collaboration and teams in virtual environments. With the globalization of the economy, more and more employees are working with team members half way around the world. In order to reduce the negative effects, developers and users of e-collaboration tools for virtual environments should address human interaction issues, as well as social issues and organizational issues.*

Keywords: *E-Collaboration, Telecommuting, Virtual environment, Virtual teams, Human-computer interaction.*

1. INTRODUCTION

Due to the technological and paradigmal developments in the area of human-computer interaction [1], the fields of smart environments, multi-modal interaction, ambient intelligence and ubiquitous computing nowadays are converging into "human computing" [2]. Human computing escalates the complexities of human-human and human-machine interaction in the already complex software engineering and system integration [3]. Emerging e-collaboration systems [4] are expected to be increasingly adapted to the nature of human cognition and communication and present a quantum leap beyond modern productivity-oriented workplace technologies in which performance is the key objective and the user experience comes after business process logic and formalized workflow.

To understand the current limitations, i.e. opportunities for improvement in e-collaboration tools and concepts and possible issues, we first need to define e-collaboration itself. Kock [5] stated that e-collaboration consists of the following elements:

- The collaborative task: A task that parties can work on together. For example, jobs beyond the capacity of one organization, or jobs that require complementary skill sets;
- The e-collaboration technology: Existing or new IT infrastructure such as teleconferencing, discussion boards and instant messaging;
- The participants: Organizations that are collaborating, industry associations and government agencies. Characteristics of the participants and size of the group can also have an effect on the collaboration;
- Mental schemas of the participants: The knowledge and experience of the participants and the degree of similarity between participants. For example, expert or novice understanding of the task;
- The physical environment: The location of the participants. For example, the geographical location of the toolmakers was dispersed and therefore they needed to apply more effort to e-collaboration, whereas the IT organizations were within the same geographical area;
- The social environment: the perceptions of trust and the behavior among the participants, as well as peer pressure among participants.

[1] Faculty of Information Studies, Ljubljanska cesta 31A, Novo mesto, Slovenia

Main goal of e-collaboration systems is to reduce the isolation of users from each other [4]. E-collaboration systems explicitly provide awareness of the users and their activities. Lynch et al. pointed out in 1990 that e-collaboration systems are distinguished from normal software by making the user aware that they is part of a group, while most other software seeks to hide and protect users from each other [6].

The social science classification of e-collaboration tools according to the main mode of interaction as proposed by [7] is presented in Figure 1. While the presented classification seems old, it is still very accurate, as it refers to the basic modes of interaction, the so-called 3C's of *communication, coordination and cooperation*, which bring forth the fourth C: *collaboration*, which can be defined as *shared creation* [8]. What has changed of course is the technology. Technical characteristics of the e-collaboration platforms, and the scope of integration of technologies today allow the user to be more productive, and support several modes of interaction within a single platform or within a solution that seamlessly integrates several platforms such as Slack [9]. A more detailed and recent classification of modes of interaction in e-collaboration systems can be seen in [10] or [11].

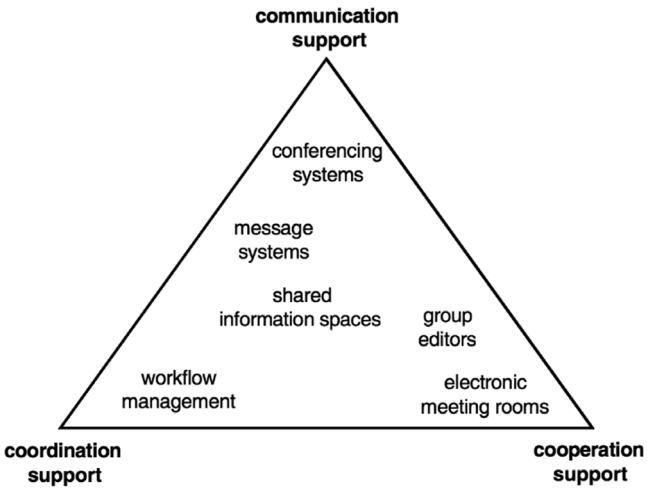

Figure 1. Classification of e-collaboration systems by the main mode of interaction supported [7]

2. E-COLLABORATION DEVELOPMENT TRENDS

Availability of solutions for e-collaboration support and their popularity has increased due to higher acceptance of telework and progress of technology, i.e. accessibility of fast internet and capabilities of mobile devices, while the recent Covid-19 crisis has given an unprecedented boost to the number of persons working from home. E-collaboration systems and tools can be categorized according to several parameters. The fundamental parameters of collaboration are the time and location or space of participating users. While the space or location can be considered as a discrete dimension, the participant's presentation in the software (we can refer that to as the dimension of artificiality) can be implemented in various combinations of synthetic and realistic representations. In this paper, we present a combination of the venerable Benfords et al. [12] model of shared spaces, which is focused on synchronous communication, along with various categorized kinds of groupware solutions. The resulting categorization of groupware solutions is shown in Table 1. Multi-purpose collaboration tools are listed in several categories, as they can be used under synchronous and asynchronous collaboration conditions, and they offer

different representation type choices. We can also observe that that some modes of collaboration are more popular, i.e. supported by a higher number of tools. For example, there are few tools intended specifically for asynchronous collaboration at the same location, as location is generally not relevant when users participate at different time slots (asynchronous collaboration).

Table 1. Proposed categorization of e-collaboration systems according to time, space and artificiality

DIMENSION OF ARTIFICIALITY	Synthetic (generated)	**AUGMENTED REALITY**	**VIRTUAL REALITY**
		Same time (synchronous)	Same time (synchronous) *e.g. virtual worlds, chat*
		Different time (asynchronous)	Different time (asynchronous) *e.g. virtual worlds, virtual spaces*
	Physical (realistic)	**PHYSICAL REALITY**	**TELE-PRESENCE**
		Same time (synchronous) *e.g. e-meetings, e-voting, e-brainstorming*	Same time (synchronous) *e.g. teleconferencing, e-meetings, screen sharing, shared documents, chat*
		Different time (asynchronous) *e.g. collaborative design, augmented reality training, workflow assistance*	Different time (asynchronous) *e.g. workflow tools, document management systems, email, shared documents, forums*
		Local (physically present)	**Remote (represented)**
		DIMENSION OF SPACE	

Source: Author's presentation

Along with the thousands of person-years, and millions of dollars, invested in the development of formal e-collaboration solutions (usually proprietary and created by professionals), a new type of community-driven e-collaboration has emerged, created in part by the open-source-software movement: web-based collaboration and content-creation tools and technologies, developed by volunteers, and freely available (under the conditions of an open-source license). On platforms like Wikipedia, content is authored and moderated by users and accessed freely through Web 2.0 based platforms [13], [14].

Web 2.0 applications are often associated with "social software". Whereas traditional software focuses on productivity and process support, web 2.0 applications focus on enabling communication, cooperation, and collaboration of individuals and groups over the internet, and can be therefore referred to as "social software". Generally speaking, collaboration software is based on different services for setting up networks and supporting the distribution of information within the network (e.g. e-mail, instant messaging, chats, or blogs) [15], however with the evolution of web technologies the range of services offered in collaboration is increasing, and new interaction concepts that appear on the web are experimented with in collaboration software as well, e.g. gamification of work [16] and leveraging social networks [17], [18] to improve e.g. social aspect of knowledge management [19].

While the concepts of gamification and social networking are in themselves not problematic, the adoption and integration of open social e-collaboration systems into a business information system can become a compliance and control nightmare, and lead to information leaks or result in public relations disasters. Additionally, platforms outside of company control may be retired without warning, leading to loss of data and (again) public relations problems. Companies should therefore introduce new collaboration platforms only if they offer an acceptable level of security and control, and avoid integrating public solutions. This does not exclude the use of commercial service platforms such as Slack or Zoom. However if the CEOs in the early 2000s

were taken by surprise by the popularity of web forums and social networks, and wondered whether to ban them at the firewall level or not, companies today should develop strategies to build employee engagement with their enterprise social networking platforms [20].

3. HUMAN-HUMAN INTERACTION ISSUES

Even if the development of technologies and concepts in e-collaboration tools has been impressive, there are still aspects of human collaboration and interaction that are yet not sufficiently supported. While "ICT allows organizations to bridge time and distance barriers with once undreamed of ease" [21], it also creates new boundaries at the level of the work unit [22], [23], [24].

Video conferences do not provide sufficient nonverbal clues, such as body language or facial expressions, e.g. gaze direction, and due to the limited angle and 2D nature of video and low audio quality offer limited information on spatial presence of participants. Videoconferencing does not generate a sensation of co-location: participants perceive only a wall of faces, and don't experience being in the same place with others; they can see whether others are looking at the camera or not, but don't know what else they may be looking at. This shortcoming of videoconferencing systems is present in today's widespread videoconferencing tools as it has been in 1997 [12], [25], [23]. Majority of the nonverbal cues that we have taken for granted at in face-to-face meetings are not present in video, e.g. body posture, hand gesture, spatial orientation, glancing, and facial expressions. And in large online meetings, passive participants may not even appear on video, giving the perception of them "lurking" in the background, like in text-based environments [26]. At this point we should mention, that face-to-face meetings in the time of Covid-19 epidemic offer limited non-verbal clues as well, due to the masks obstructing a large part of participants' faces.

A lack of nonverbal cues and is especially problematic in intercultural communication, a relevant issue in virtual enterprises and globalized economy [27], [28], [23], [29]. While companies can provide training in intercultural communication and nuances in verbal communication, detection of those via a limited communication channel such as videoconferencing is difficult. Research shows that certain types of media are more useful for certain types of knowledge sharing depending on the cultural and linguistic variation between the communicating parties [30].

4. ISSUES IN SOCIO-TECHNICAL SYSTEMS

A technology is successful only if it is adopted by the users, and that depends on the correspondence between technology and the user's requirements, their preferred workflow, and their organizational culture. Therefore, e-collaboration systems can bring added value only if they suitably support (and improve) the existing socio-technical systems. Put plainly, users need to have good reasons to use a work-related e-collaboration tool or platform. A tool will be perceived as useful only if the users can accomplish more, or more easily by using it. Therefore, the collaborative tools offered within the environment should offer an improvement to the current workflow. However, humans are not robots, but social creatures, and therefore any social e-collaboration tools should support social activity and engagement, a feature that hasn't been appropriately recognized in previous CVE research [31], [32], [33]. This may mean allowing for chance meetings (equivalent to bumping into a person on the corridor). Impromptu, informal meetings with colleagues can strengthen social ties and allow informal passing of information, which can be crucial to knowledge workers, as knowledge also has a social component. Infor-

mal meetings build a sense of belonging to a team and are essential in the construction of an organizational culture. However, informal meetings can take place only if the participants are present at the same time - a synchronous rather than asynchronous presence.

As the term socio-technical suggests, the technological system and the social system are interrelated and need to be developed in tandem for the whole socio-technical system to be successful. If a technical system (e.g. a new e-collaboration platform) is introduced at the expense of a well-accepted social system, the results will be counterproductive. To cite Koch [34], the main take-aways from the socio-technical systems for e-collaboration discussion are:

- technical systems (e-collaboration support technology) are highly embedded in social systems,
- the social and the technical subsystems should be optimized (designed) in parallel, because they influence each other,
- the goal/task of the overall system should not be forgotten as it represents a source for coherence of the system.

6. CONCLUSION

A successful implementation a new e-collaboration system necessarily involves the social aspect, as company culture may need to adapt to new workflow and collaboration modes introduced by the e-collaboration system. User involvement from an early phase of development (needs analysis) can bring us closer to an optimal e-collaboration system design. Participatory design principles should therefore be followed to inform the socio-technical system development not only from technological but also organizational and social aspects. For example, in an implementation of an intranet social network system, the team leader should involve all team members from the beginning. Ideally, one would start with a discussion to identify the business processes to be supported with the social network.

To enable a safe and effective use of an open e-collaboration system, a company should first ensure the information security of the new system, including the points of integration with existing systems, the control of any data the employees may enter or create in the new system, and then help their employees explore the possibilities, without unnecessary restrictions, avoiding errors others have made before. Key to success is to strike the right balance between providing the right guidelines and leaving enough freedom for users to develop their own ways of using the e-collaboration tools, and monitor the evolving process in order to identify problems and good practices. Insufficient guidance might lead to an ineffective diversity, but too much guidance might kill the important “fun factor”. Consequently, the guidelines should be developed in a participative approach in close cooperation with the end users.

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