Towards an understanding of Common Information Spaces in Distributed and Mobile Work

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Abstract

Collaborative tasks necessitate the pro-active role of users in interpreting the nature of occurring events and in evaluating the coordinated use of resources in shared spaces. Through fieldwork observational studies, this research, aims to depict a picture of diverse instances of Common Information Spaces (CIS) and reveals the impact of communication and information technologies on collaborative work practices.

1 Introduction

The study described in this paper aims to unpack the socio-organisational domain, where collaborative activities are performed, as well as comprehend the nature of the overall resources employed to support them. We argue that collaborative tasks are not just a collection of objects and events but that they also require the user to interpret actively the shared context where collaboration takes place and the resources through which collaboration is achieved. This study reveals two aspects relevant to the understanding of collaborative work: i) the creation and management of Collaborative Information Spaces [Bannon and Bødker, 1997] and ii) the coordination of mobile work in collaborative work practices.

2 Methodology

Through the use of fieldwork an ethnographic oriented methodology was used to document users' activities, their context of work and the artefacts they employed. The data collection covered a period of time of approximately eight months, in a variety of working environments, and employed techniques such as digital video recording, contextual interviews and participatory user data reviews. The latter were particularly relevant for the outcome of this research. Informants participated in collaborative sessions where they reviewed some of the observational data and provided useful insight into the understanding of critical collaborative scenarios that highlighted the disruptions that can be caused by the use of technology in collaboration.

We tried to frame the study within a consistent domain of observation: therefore, three organisations were selected on the bases of the activities they performed. The three teams that were shadowed were all involved in design activities of different types, as listed below:

- the conceptual design of an information appliance;

- the engineering design of an innovative public building;
- the design of a new set of national standards in construction procedures

3 Observations: nature of CIS

One of the core idea within Computer Supported Cooperative Work (CSCW) is that cooperative activities require a communication - or shared informational - space as a common ground [Moran and Anderson, 1990] by which properties such as mobility and awareness become relevant to the overall collaborative performance. Such a notion has been extended and formalized by Bannon and Bødker [Bannon and Bødker, 1997] emphasizing the role of the collaborative informational space, CIS, as the set of available resources enabling creative decision making processes.
Three diverse instances of collaborative work emerged from the observations:

- a physically-centred collaborative space (the project space), a dedicated environment where a group of professional designers collected and manipulated information in order to support their activities;
- a virtual space, resulting from the combination of web application and video conferencing technologies for the collection, retrieval and storage of organisational knowledge to support problem solving activities;
- a distributed space arising from the collected use of several digital devices (mobile phones, faxes etc.) and protocols of communication (circulation of the people, email, snail mail etc.) in order to overcome the obstacles imposed by remote collaboration.

All the instances of collaborative space observed in this study do not find counterparts just in the physical world. They resemble more a collection of established organisational practices and technologies used to achieve collaborative tasks. This observation led us to postulate that we cannot rigidly define collaborative space by simply considering its physical boundaries. This consideration thus directed our research towards:

- the identification of those tasks that make up the dimensions of collaborative work such as collective brainstorming, displaying, capturing, collecting-storing-retrieving information and task distribution;
- the understanding of how co-ordination can be achieved by the employment of resources in situations such as meetings, (physical and virtual *containers* for the coordination of the team members' tasks) and to link and manage the streams of individual and collaborative work;
- the analysis of the impact of individual's mobility on collaborative spaces considering how work on the move often stretches the boundaries of the collaborative dimension, violating the social rules of the work environment and requiring instantaneous re-arrangement of the modalities of work to avoid *breakdowns*.

4 Findings

This section provides an overview of the main points of interest emerging from our field data. Firstly, we illustrate how using physical space and resources impact on collaboration at an individual level of granularity. We briefly describe the combined use of the devices within the space to facilitate the work practice. Secondly we introduce the repercussions of physically centred work practices on a collaborative dimension.

4.1 A Physically centred space for the performance of collaborative work

Physical space is currently the most effective way to support collaborative activities due to the natural interaction that individuals are able to establish with their environmental resources. From an evolutionary point of view human kind has learnt how to structure their environment in order to have the best chance of success. This cognitive strategy is often referred to as *'structural coupling'* (Kirsh, 1995) and it highlights how space cohabitants and structures evolve simultaneously in an interwoven *ecology* that resembles biological systems. The parallelisms between ecology and the office have been drawn already [Kirsh, 2001] and it seems in this context to be appropriate to describe the advantages that the physical work environment provides at an individual and cooperative level. The project space that we observed was a dedicated room without any PC or land phone connection. Beside the personal stationery that each individual brought into the room, paper-based artefacts were mainly available: foam boards, whiteboards, flip-charts and post-it notes. The consistent availability of the project space together with the flexibility offered by the combined use of resources constituted the means through which individuals were able to support the design process.

At an individual level the advantages offered by the physical space (in our interpretation also encompassing artefacts) can be listed as follows:

- *To simplify choice.*

Information relevant to the design process was collected as prints out, hand-written notes, sketches, photos etc. pinned down to foam boards. Several foam boards were placed around the perimeter of the room and over time constituted a layered structure resembling an onion ring. In order to highlight only the information strictly necessary for the task the relevant foam boards were put on the foreground thereby channelling the attention of the team. The unneeded information was hidden away, in storage, for later use.

- *To simplify perception.*

In the design review process, design concepts were sketched on cards and tested with the users. The users' evaluations were summarised into good and bad points and transcribed on to post-it notes of different colours. The post-it notes were then stacked at the bottom of the cards that were progressively positioned on a new board, which collected the concepts the teams dealt with. The symbolic positioning of the cards and the clustering strategies used to add the users' evaluations to the concepts allowed the team members to detect, with a quick glance, what stage of the process they were at and to plan future activities accordingly. Also this structural strategy enhanced awareness in those team members that were not present during the revision by providing a tangible representation of the performed task that they could effortlessly access.

- *To simplify internal computation.*

Toward the end of the project, the design team started to prepare a brochure to be presented to the client. At that stage the design concepts considered most promising were expanded and each of them occupied a whole foam board. They were also laid-out in A4 pages. The project manager had the task of leading the creation of a suitable arrangement of the concepts according to a structure that made sense for the brochure. The manager wrote the names of the different concepts down initially and then attempted a possible order sequence on a sheet of paper. Next she placed the A4 sheets on the table according to the written sequence. Once she had all the A4 papers spread on the table she moved them around until she achieved a more satisfactory arrangement, which was then mirrored in the project space by the positioning of the foam boards in identical sequence. The support provided by the external representations of the concepts on the A4 sheets allowed the individual to delegate to the environment cognitive tasks that she would have had to perform

internally otherwise. The manipulations were operated on physical objects that embedded the information processes and retained memory of it in the represented structure. Moreover by mirroring in the environment the order of the concepts, the whole team was made aware of the ongoing task and the team could comment on this since it was effortlessly available.

From the points illustrated above it is also possible to envision how the creation of a physical project space can enhance features that are fundamental for collaboration [Kirsh, 1995], for example, by providing:

- Peripheral awareness of co-workers that could aid keeping track of the overall team activity;
- Joint monitoring of the devices, present in the room, that embedded the history of the collective work practice;
- Broadcast communications without additional effort, since the distribution of the tasks is embedded in the environment and easily accessible.

Working in the same environment where the information is organized offers overall the benefit of using the physical space to back up any potential disruption caused by human or technological factors. However, a physical collaborative space is not the most common manifestation of a CIS because collaboration often occurs in a distributed way; and organisations seldom support or even envision a project space as beneficial to the work.

4.2 Distributed and virtual collaborative places

The teams that did not benefit from the support of a physical collaborative space configured their work practices around the limitation and the assistance that the available technology provided them with. However when technology fails, in order to secure the team's overall performance, demanding and overwhelming work strategies need to be adopted at the expense of the individual. The virtual CIS observed displayed only short-term advantages. In the longer term, when the complexity of the activities increased, the team members needed someone to mediate and manage the shared space that they had created. Moreover the lack of connection between web based technologies and the teleconferencing system to simulate a synthesized virtual environment caused disruption between the creation of knowledge during the decision making process (on-line meetings) and the updating of that information on the web (repository of the team knowledge). Virtual and distributed spaces, in general support only a few aspects of collaborative work when compared to the richness offered by a physical collaborative space with its accompanying advantage of situated awareness. Lack of awareness in the virtual and distributed CIS's led to impoverished interpretations of the objects and events in the shared space by the actors involved, ultimately culminating in a proliferation of breakdowns.
The observation of remote collaboration also opened up this study to the investigation of the relationship between mobile work and the creation and maintenance of collaborative spaces.

4.3. Stretching the boundaries of collaboration: mobility

Individuals working on the move need to order their activities taking into account the deprivation they will experience because the majority of the resources available in fixed collaborative environments are missing. Using the idea of place in collaboration (emerging from space and accompanying structural resources) [Harrison and Dourish, 1996], we observed that for mobile workers, the collaborative workplace consisted primarily of the communication that the mobile phone was able to support. We observed that mobile workers have to focus their activities on the information transmitted and on the space for collaboration created by mobile phones because no

other artefacts used on the move were as capable of supporting such *heterogeneous* activities. Mobile phones were used by the majority of mobile workers because they are extremely flexible artefacts: facilitating an immediate response to events while allowing the sharing of attention across other cognitive activities such as walking, dealing with travelling procedures and so forth. However, although mobile phones were the most popular resources for those on the move they constrained the patterns of collaboration possible to the user because of the limited nature of the communication they can currently support.

Although the use of the mobile phone allowed individuals to still reach colleagues and to establish basic forms of communication and interaction, the resulting communication was often extremely impoverished and unable to support an individual's desire to access a rich amount of collaborative knowledge on the move. Such information could be partly accessed by combining the use of several artefacts together - but this arrangement more often than not, generated uncomfortable modalities of work because the technologies in use were predominantly desktop oriented. The co-ordination of multiple artefacts concurrently also necessitated a great deal of planning *a priori*. This inevitably forced individual's to seek a tabletop or flat-surface to work on while also demanding an almost exclusive focus of attention - thereby depleting mobile work from some of it's primary characteristics, i.e. flexibility and spontaneity.

5 Conclusions

In conclusion, a common observation across our fieldwork was the disruption generated by the current digital technology used in emergent workplaces. These disruptions are often avoided or reduced through expensive cognitive behaviours that individuals employ. However, these alternative strategies for keeping collaboration alive often resulted in inefficient working practices and in impoverished cooperation. Also on the basis of our research findings we stress the inadequacies of current mobile technologies to support access to collaborative knowledge on the move. Users seek to experience at least *engagement* in their virtual communities through the use of the mobile phone but the demands of the devices are essentially disruptive and impoverished. As we have illustrated above users are left with the need to plan in advance to accomplish work that should instead be achieved from more flexible and spontaneous activities.

6 References

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