

Sustainable Workplace: A Study of Mobile Knowledge Work - Practice Motivating Theory Development

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1. Introduction

This paper draws on the results of several research projects focused on studies of interaction in the real-life workplace. The projects share one key characteristic – they all involved strong collaboration with industry, notably the construction industry and the related disciplines of architecture and workplace design. The focus of this paper is on the input of empirical workplace studies to the development of a human environment framework that captures key features of both face-to-face and computer-mediated communication. Computer-mediation of day-to-day cooperative activities is regarded as an integral part of the ‘hybrid’ workplace, that is, the workplace that integrates physical and computerised resources to facilitate communication and collaboration across spatial, organisational and social divides. From a theoretical point of view, the main aim of this work is to outline an analytical approach that takes into account the role of broad non-linguistic context in shaping co-action, with particular emphasis on spatial and organisational features. From a practical point of view, such a framework is needed to inform the design of collaborative work environment of the future where the traditional workplace resources are enhanced with facilities provided by information and communications technologies.

The requirements of real-life workplace for support of day-to-day communicative and co-operative activities were initially analysed within the CICC project¹. The research was user-driven and interdisciplinary, focused on the development and use of interactive technology in large-scale construction projects. It was motivated by the needs of people working in construction and manufacturing industries, where poor communication causes serious problems in day to day activities which require continuous cooperation and coordination (Fruchter, 1998).

New technologies such as multimedia, mobile telephones, wearable computers and video were introduced into a large-scale construction project² to address the communication requirements of construction teams. The technology support was designed to improve communication within and between teams characterised by professional and cultural diversity, and to offer a richer information environment for the repair of breakdowns and misunderstandings. Such a facility is particularly useful in agile project teams, where a stable organisational form is absent as a team is created for the purposes of a particular project and is dissolved once the project is completed. The work on the project itself represents a period during which co-1 European research project funded under Framework IV ACTs programme: CICC (Collaborative Integrated Communications for Construction, ACTS No. 017), September 1995-March 1999.

2 Bluewater, a £20M project, building a shopping mall in Kent, with 120 sub-contractors. Workplace studies were carried out over a period of three years.

operation is vital. Problems of lack of shared culture have to be addressed and this is usually done with a series of induction meetings and seminars at the start of the project. This is a vital yet time-consuming team building stage of the project, and is undermined by teams joining projects at later stages with consequent integration problems (D14, CICC report, Rosenberg, 1998).

To support natural interactions in this context, the working assumption is that team members together build a shared environment where they co-operate to solve their work problem. They co-ordinate their actions and focus on common artefacts (for example documents, drawings or a computer screen) in the process of negotiating the meanings of words or images presented there (Robinson, 1993). They thus create the common ground – “a sine qua non for everything we do with others... the sum of [the participants’] mutual, common or joint knowledge, beliefs, and suppositions” (Clark 1996, p 92).

Within the boundaries of the common ground the participants can identify the objects referred to, come to understand each other’s goals and purposes, co-operate and co-ordinate their actions. Indeed, common ground is regarded as fundamental to all co-ordination activities and to collaboration (Clark & Brennan 1991). In this context, one of the key research questions was ‘How do people create the common ground in situations where the contact between them is influenced or mediated by technology?’ (Rogers, 1993; Heath & Luff 1991).

Usable interactive technology is expected to facilitate the processes that shape human cognition and communication in the significant social and cultural contexts, thus fitting in with normal human activities in the workplace. The technology is thus regarded as an integral part of the entire information environment of the ‘hybrid workplace’ created by the interaction of people, organisations and artefacts where information is generated, exchanged, stored, processed, internalised and externalised.

2. User and workplace requirements

From the perspective of day-to-day activities in the workplace, individuals work in any number of places, their homes, other people’s offices, as well as various public places such as libraries, parks, and cafés. They also work when traveling – in cars, trains, planes, and in lounges, waiting rooms and lobbies. They maintain contact both with their homes and their offices, enjoying flexible working conditions because information and communications technologies enable them to communicate and work together, albeit ‘at-arm’s-length’.

The key issues for workplace design concern the nature of such a distributed workplace and the resources such a workplace has to offer. Such resources include not only work-space and furniture but also technology-enabled connectivity to other work-spaces and the representations of people who are not physically co-present.

Moreover, being connected is a pre-requisite for re-creating the essential features of an effective workplace in a mediated environment. A ‘hybrid’ work environment, that integrates physical and mediated spaces for communication and collaboration, must provide access to different kinds of work space as required by its occupants, as well as allowing them to develop normal social and cultural rela-

tionships based on trust, friendship and organisational identity and belonging. This is a challenge for distributed teams, since communities have traditionally relied on proximity to bind them together into a 'local culture' where members share the available resources, speak the common language, dress and behave in ways that are appropriate for the customs, values and beliefs of their community.

If the visions of the workplace of the future can be expressed in few words, the most appropriate would be 'distributed networked enterprises'. In the world of business, the current ideal form has shifted from large multi-national corporations rich in property, equipment and workforce, towards smaller, but more flexible autonomous units that are more adaptable and responsive to changes in the business environment. An appropriate metaphor is that of an elephant giving way to a gazelle. Consequently, the sustainable workplace of the future will be distributed because its workforce will be increasingly more mobile and because large hierarchical organizational structures will be replaced by smaller and less hierarchical, but highly networked organizations in consortia and partnerships with similar enterprises working together as agile teams.

The research into various aspects of the workplace of the future was primarily carried out in two EU-funded, large-scale projects CICC (cf. above) and SANE³, but it was complemented by a number of smaller projects focusing on communication in physical and media environments in collaboration with the designers and developers of Virtual Reality applications and context-aware technologies⁴, the use of drama techniques in the design of virtual and augmented reality interfaces⁵, as well as the work oriented towards the role of language technologies in the context of computer-mediated communication in the workplace⁶. The application of this research falls into three main domains – introducing information and communication technologies into a distributed organisation in construction and manufacturing⁷, education⁸, architecture and workplace design⁹. Special emphasis is given to understanding the impact of the technology-based innovation on the established patterns of collaboration and communication in these domains.

The key outcome of these projects is our increased understanding of the information environment in the workplace that takes the centrality of interactive technology a step further. The mobile workplace is location-independent as it enables people to work anywhere, anytime since it extends the resources from a physical space to a 'virtual' or 'augmented' space mediated by technology.

The study of computer-mediated communication in a location-independ-

3 EU Framework 5 IST project Sustainable Accommodation for the New Economy, IST 2000-25-257.

4 BT University Research Fellowship at the BT Research Laboratories during 1998-99.

5 LIVE (Language in Virtual Environments) 1998-2000, sponsored by ISCE (Institute for the Study of Coherence and Emergence)

6 SCALE (Internet-based intelligent tool to support collaborative argumentation-based learning in secondary schools), EU F5 2001-2003, and Leverhulme Visiting Professorship 2003 – 04.

7 Sponsored by STENT Foundations Plc and BICC (British Insulated Cable Company), both part of Balfour Beatty Construction.

8 More specifically, using Virtual Reality in education, funded by the Nuffield Foundation scholarship.

9 PhD scholarship funded by the Academy of Science, Finland.

ent workplace is focused on addressing several research questions concerning the key features of context of coordinated action and communication (co-action) in such a workplace. Firstly, we aimed to establish the extent to which space, people, work and technology, are interrelated, and the extent to which these relationships influence co-action either directly or indirectly. Secondly, we developed a framework to identify the extent to which the interrelated settings of space, people, work and technology can be configured so that they improve facilities for co-action. Finally, we examined the theoretical and methodological issues involved in our attempt to understand and design the workplace of the future in order to enhance its proximity, permanence and productivity.

3. Space, people, work and technology

As the ultimate aim of this research is to inform the design of the hybrid workplace and of the information and communication technology as an integral part of it, we pay special attention to the nature of the broad-based human environment in the real-life workplace. We do this by examining primarily the roles, responsibilities and contributions of the individuals to team work, whose patterns of interaction involving the interplay of individual and joint action are the main focus of our empirical study.

One of the most interesting features of the real-life workplace concerns different kinds and different degrees of responsibility that individuals have in particular communications in the work context. These responsibilities may be assigned, that is, they are a part of the formal duties and positions, such as Project Director, Project Manager, Assistant Project Manager, depending on the nature of the work tasks. They are also assumed, that is, in any particular instance, an individual is expected to make a contribution in accordance with her expertise, experience or preference, such as advising colleagues on IT matters or researching a particular topic. These are not 'given' but adopted depending on the particular circumstances in which a particular team engages in a particular task.

The assumed roles and the resulting contributions are only partially determined by the status of an individual in the organisation, reflecting instead the requirements of day-to-day collaborative activities and individual engagement with others. It is in this context that the interaction between individual and joint action provides the basis for creating and maintaining the common ground.

The outcomes from the empirical studies of day-to-day collaboration in the real-life workplace suggest that individuals take on roles that are formally assigned from an organisational aspect and informally assumed from a communicative or conversational aspect. As they negotiate and define boundaries in collaborative environments, the ways in which different roles are assumed informally, varied from situation to situation, and frequently included the use of space. This seemed to be quite a powerful way for individuals to pursue their own intentions. For example, if someone walked to the front of the meeting, it was clearly the way to express that s/he wanted (and had the right to expect) the attention of the whole audience to focus on him/her, compared with someone else, who just talked from his place or perhaps stood up to say his/ her opinion. Someone else could 'take the floor' in a more indirect and yet powerful way, such as walking to the white board and pulling

things together by writing a few lines, without needing to say much or anything.

This kind of individual action and its recognition by others is of critical importance in negotiating the nature and the degree of involvement, participation and contribution that an individual makes to the joint activity. In the physical work setting, the interplay between the individual and joint action occurs spontaneously and most of the time, un-problematically, but in mediated settings it has not been possible to represent the context of the situation to sufficient degree of richness and subtlety.

The initial phase of our empirical study was thus directed towards increasing our understanding of the broad non-linguistic context of a traditional workplace so that it can guide the design of the hybrid workplace of the future. Our initial hypothesis is therefore that we need to understand how organisational and conversational roles of individuals in teamwork shape the interplay between individual and joint action and thus indirectly influence the manner in which the common ground is created and maintained.

A further hypothesis is that the roles and responsibilities individuals hold by virtue of their status in the team (organisational roles) and are able to assume in the course of their work with the team (conversational roles) influence how they define their work tasks and how they organize their workspace. These in turn influence their requirements for workplace resources (including technology) and their use of the resources to interact with their co-workers. From this we attempt to distinguish how work space, work tasks, and technology function together as key elements of the work context in both traditional and hybrid workplace.

However, the clear distinction we make in our analytical framework between organisational and conversational roles is not entirely consistent with how these roles, in practice, influence the key features of the work context; the work space, work tasks and technology. Our empirical results show that there is a systematic ambiguity between ‘assigned’ organisational roles and ‘assumed’ conversational roles. For this reason we assume that the key features of the work context are also constrained and/or defined by conflicting influences such as organisational culture, power relationships, timescales and other workplace features. In particular, we focus on the ways these constraints manifest themselves as legitimate requirements for access to people and information on the one hand, and privacy and confidentiality to protect from outside intrusion on the other.

Moreover, it is these constraints that lead to patterns of variation in the work context – which is precisely what our approach needs to explicate if it is to inform the design of a ‘hybrid’ workplace where computer-mediated setting provides the same degree of proximity, permanence and productivity as an effective physical workplace is known to do. Empirical studies in both CICC and SANE projects show that mobile workers need *permanent spaces of interaction*: spaces that are not purely informational but provide a sense of permanency (or belonging) to the team and the organisation. In addition, informants demonstrated that mobile workers need *proximate spaces of interaction*: spaces that can sustain appropriate degrees of closeness between workers and foster interaction between colleagues working at different times and in different locations, whilst maintaining access and privacy that individuals and groups are entitled to by virtue of their roles and responsibilities. The

studies in the SANE project also identify that mobile workers require *productive spaces of interaction*: spaces that allow access to shared resources from any number of locations and which provide mobile workers with the flexibility to organise the space and time of their activities.

For example, if an individual, in her 'assigned' role as a consultant has the option to work from home, but needs to draw upon the expertise of others she might 'assume' the role of a researcher and commute to the office in the expectation of meeting up with colleagues in her own team and from other projects. The contextual variations offered by commuting to the office whilst limiting her activities in some respects give her the opportunity to explore others. Therefore, an individual will choose a particular work setting depending on the particular role she has assumed to bring her closer to completing the work task. An effective workplace (and this holds true of a location-independent one as well) thus needs to provide her with work settings that support a range of 'possible' communicative activities and opportunities for effective co-action with her colleagues.

However, when the individual arrives at the office she might be unexpectedly constrained not only by the availability of her colleagues, but her tasks and activities might also be redefined by the distractions of phone calls from clients, or perhaps by her manager who decides to capitalise on her unexpected presence in the office by calling a spontaneous meeting. The individual, although still able to meet up with some of her colleagues, is obliged to reconcile the ambiguity between her organisational and conversational roles through alternating her assigned (consultant) and assumed (researcher) roles respectively. Moreover she is obliged to form her collaborative network by adapting the 'potential' to the 'actual' communicative activities in her work context.

From interviews and focus groups with the informants (knowledge workers who spend substantial amounts of time working away from their office) we concluded that it is the 'actual' communicative activities that determine how individuals and teams create the common ground, in their words – 'how they manage knowledge and information in their own systems and in their own networks'.

Organisations assign roles but the critical factor is the assumed roles, because these are the roles individuals can, when working together, generally interchange in order to adapt to constraints on communicative activity. It is these constraints that produce variations in the work context, but the drivers of these variations are the roles and responsibilities that individuals assume in relation to the communicative activities they undertake. For example, an individual might assume a role that allows them to contribute their skills to the dynamic relationships that are formed in a new collaborative event. Such an event might necessitate a response to not only a prior communicative situation, but also the unexpected, day-to-day, series of related events and circumstances. The individual, therefore, must assume a role that allows him or her to adapt to the constraints imposed in a previous communicative situation - one that obliges them to dynamically reconstitute, and expand those roles and responsibilities in ever more complex variations. Hence roles become the drivers of the variations in the work context that determine the appropriateness of its resources for co-action and communication.

4. Work settings for co-action and communication

As communication is essentially in service of performing common tasks, there is a wide variety of conversational modes that a theoretical framework has to account for. Interaction sometimes takes the form of face-to-face conversations in meetings, but it just as often involves “communication at-arm’s-length”. This is conducted by means of shared representations of information in, for example, documents e-mailed to interested individuals, in project and bulletin boards which constitute public information spaces, and, more recently, through technology-mediated channels, such as media and virtual spaces, web archives, chat logs and others.

One of the implications of the real-world perspective for the theoretical framework is that we need to take into account the ways people engaged in conversations make use of information obtained from other channels and other resources. These channels and resources provide information that is as important for creating the common ground as the information obtained from the conversation itself (Rogers, op.cit). In technology-mediated conversations ways must be found to make such information accessible to all those who share the mediated workplace. For example, in the virtual workplace it will be necessary to design representations to show not only speakers/listeners and their talk, but also the background information in the setting, and in documents, drawings and objects they use as shared artefacts to focus on and organise their talk.

Another implication concerns different degrees of individual involvement in conversations or meetings. As Clark (op.cit, p. 197) points out, “listeners who participate in a conversational interaction go about understanding very differently from those who are excluded from it”. In the design of hybrid work environments we need to account for different degrees of commitment and responsibility that are required of individuals, as well as identifying the appropriateness conditions for changes in their involvement. This is to account for the fact that in an open-plan office, for example, people frequently join conversations as and when they perceive the topic to be relevant to their immediate concerns and drop out of conversations to get on with more urgent tasks. Furthermore, people often left ‘traces’ of their activities in the office that informed others of their whereabouts. For example, in the management hut at a construction site, engineers frequently left recent documents open on their desks as deliberate traces of their actions to be ‘picked up’ by colleagues in their absence, or placed their boots and hardhats in visible positions near the desk to indicate that they were away from the office, but not on the construction site.

These observations of the strategies people used to coordinate actions of mobile team members lead us to distinguish three types of conversational roles. First, we defined the participants whose aim is to establish reciprocal relationships that guide the creation of the common ground and who actively control the process. Second, we characterise over-hearers who observe, and indeed overhear, conversations whilst relying on their shared knowledge of the work context in order to interpret the participants’ actions and behaviour. They thus infer the significance of the participants’ words and actions, implicitly sharing in their reciprocal relationships. Third, we characterise the trackers who do not have access to the communicative activity itself, but are able to rely on their mutual knowledge of the work context in

order to reconstruct what was said and what was decided.

There seem to be significant differences in the nature of informational resources that are required by “participants” who will share the contributions and responsibilities for taking up each other’s projected actions, “over-hearers” who will pick up information about the conversation through observing and interpreting the actions of active participants, and “trackers” who will find out about it through accessing traces of participants’ actions in records or other shared artefacts.

Much research has been done in the creation of the common ground in synchronous co-located communication (Clark, op.cit), but the empirical studies of real-life workplace show that the context of communication there presents additional challenges, as illustrated in Figure 1.

First of all, the importance of overhearing in an open-plan office, for example, is confirmed by the informants, who as a rule, need to be aware of a number of conversations taking place around them at the same time. When they share the work space with other members of their team, they also need to be in a position to join conversations and leave as appropriate for the effective performance of their work tasks. Thus far this is only possible in the traditional, co-located workplace where people, informational resources and other shared artefacts are integrated into the work settings, whilst the facilities for computer-mediated communication support mainly the active participants, not overhearers or trackers.

Secondly, in situations where individuals can choose whether to be in the office or not, we need to explore under what circumstances they make those choices, and in particular, how the assumed roles and responsibilities influence the choices. As one of our informants, a project manager and, within his team, an acknowledged expert in information and communication technologies, said: ‘... I then go to the office so that everyone can have a piece of me....’

The research questions following from these empirical observations relevant to the development of an analytical framework concern the key features of the work context for co-action in the real-life workplace and, from the design point of view, the range of the communication channels that need to be provided in order to facilitate and constrain co-action in such a workplace.

In particular, our current research is focused on providing answers to the questions: ‘What are the resources that a physical workplace provides, not only for active participants, but also for overhearers and trackers?’ ‘What determines how these resources are used to support their choices of assumed roles and responsibilities?’ Finally, ‘how is the resulting shared knowledge retained in the common ground of participants, overhearers and trackers?’

In the case of participants, over-hearers and trackers in non-collocated settings, communication is possible only through the functions of interfaces and gatekeepers that provide informational links and boundaries respectively. These concern technology-based resources available in synchronous and asynchronous communication in co-located and non-co-located settings, as shown in the diagram above. Again, the key research question is how is the resulting shared knowledge retained in the common ground of participants, overhearers and trackers, and, to paraphrase our informant, why can’t everyone have a piece of him when he is out of the office, but connected with them all in some form of a mediated setting?

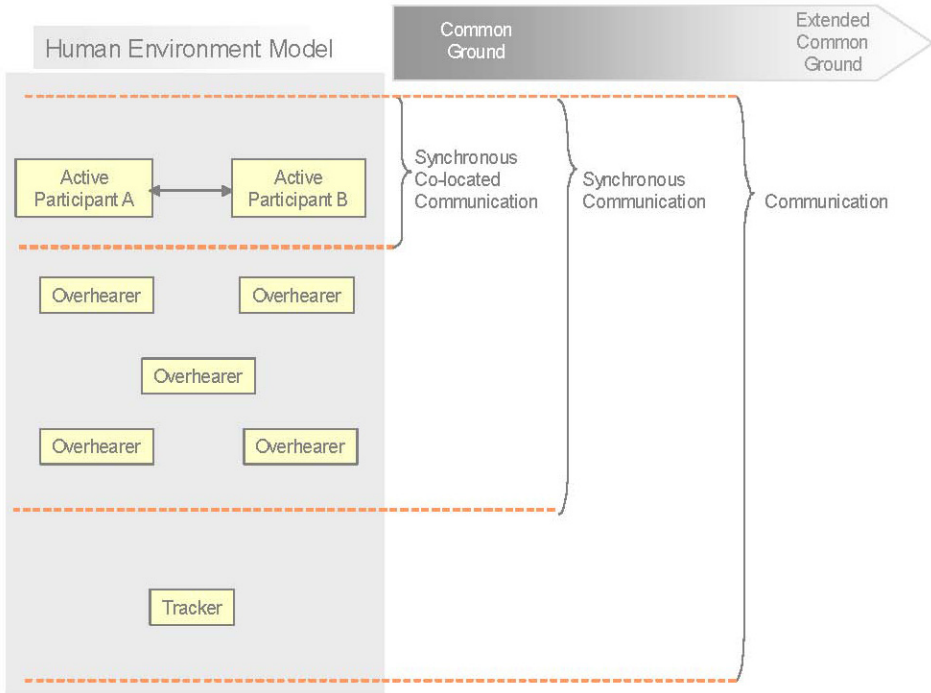


Figure 1

In mediated settings, we need to understand in what ways and to what extent the technology constrains how the information from variety of sources gets integrated into the common ground of participants, over-hearers and trackers, that is, how are various communication channels co-ordinated? Furthermore, what function do individual channels have in this context and how they relate to the use of shared artefacts, and the functions of interfaces and gatekeepers?

These questions have been addressed in collaboration with architects and urban planners, as well as technology specialists who were partners in the SANE project. As mentioned above, our empirical results show that the distinction between ‘assigned’ organisational roles and ‘assumed’ conversational roles is rarely clear cut in practice. Their interdependence is moderated by conflicting influences such as organisational culture, power relationships, timescales and other workplace features. In the post-empirical phase of our research, we focus primarily on the ways these constraints manifest themselves as requirements for access to people and information on the one hand, and privacy and confidentiality on the other.

Key issues were addressed with reference to a spatial model that classifies workspace into three categories. The metaphors for these categories are cloister, club and café. “Cloister” is a private space that does not allow interruption from outsiders and is suitable for handling and exchanging confidential information, by individuals alone or by active participants of a closed team where overhearing is barred and tracking significantly limited to the chosen few. “Club” is a space where access is restricted to “members only” but allows spontaneous as well as formal exchanges among them. Participation, overhearing and tracking are all acceptable modes of co-

action provided the members have legitimate assigned and assumed roles. “Café” is an open-access space where anybody can join and contribute¹⁰.

From the point of view of space we can recognise three main categories – private space that individuals withdraw to avoid contact with others (a metaphoric example is that of a cloister in a monastery), privileged space where only certain categories of people are allowed in (such as a club for directors, doctors, naval officers, etc.), and public where everyone can enter (for example, a café). Different types of space require different boundaries. In the physical environment walls and doors provide the strongest boundaries between public spaces on the one hand, and private and privileged on the other, although, in an open plan office, there may be partitions to symbolise a visual boundary, or a person wearing headphones is recognised as having established an audio boundary.

Similarly, groups of people may indicate their boundaries through configurations in space, a circle for example, which does not automatically allow outsiders to join in (cf. Kendon, 1990). In a public space, there are no boundaries, but such a space may be occupied by groups or individuals who have created their own restricted or private space by virtue of their behaviour. We therefore recognise that the three ‘pure’ categories of space are in reality a series of ‘interlocking’ spaces, where an individual may be simultaneously in a private space inside a public one, or where a group may be in an interlocking privileged/public space.

These distinctions are important for the study of people’s behaviour in such spaces, and in particular, for the study of communication where the resources available in such spaces influence individual and joint actions, and the interplay between them. From the perspective of co-action and communication, these three main types of space correspond to personal, social and open zones where different norms of appropriate behaviour apply. In particular, people in the personal zone are expected to show openness towards each other, intimacy and trust, where misconduct may be perceived as rejection and result in personal offence. In the social zone, the rules established by a particular community determine who is in and who is out, as well as how appropriate behaviour should be regulated. In the open zone, there are no membership restrictions, but sanctions against misbehaviour may result in police intervention, fines or any other form of legal or political control. These norms of appropriate behaviour regulate the social dimension of private, privileged and public spaces and influence the way people use these spaces.

Thus the initial framework for analysing interactions in the three kinds of space used the metaphors of cloister, club and café as the starting point for describing key contextual features of the workplace. Special attention was given to the requirements for privacy of people, confidentiality of information, as well as presence and sharing in the work context.

Subsequent analysis of communicative activities in these spaces is aimed at capturing the dimensions of the work context that characterise the ‘interaction spaces’ people create in the process of establishing the common ground. The meth-

¹⁰ The metaphors were originally developed at DEG W, one of the SANE partners specialising in workplace design, and were subsequently formalised in the context of the uniform framework that takes into account the place, people and process factors in workplace design. For the purpose of developing the Human Environment Framework, we aligned the spatial metaphors with appropriate conversational roles and responsibilities.

odology relies on observable actions, changes in shared artefacts and the communicative effect of these “implicit communications” on participants, over-hearers and trackers¹¹.

5. Collaborative work environments: Theoretical and methodological issues

As discussed above, we developed the CWE approach to cover a broad range of communication phenomena that have been observed as part of the empirical workplace studies. Initial empirical observations provided the basis for articulation of hypotheses and research questions that were iteratively refined through investigations focused on co-action in a ‘hybrid’ workplace. Such an eclectic approach to the empirical study was motivated by the requirement that the empirical findings inform the development of an analytical framework where the organisational, spatial and social perspectives on co-action are accounted for at the same level of analysis. This framework can then guide the design of the workplace of the future since it has preserved the full complexity of the human environment in such a workplace.

5.1 Boundaries in CWE

Our working assumption that people create an interaction space which establishes boundaries in terms of space and time around particular communicative events lead us to focus on the nature of these boundaries and their representations in the hybrid workplace. Within those boundaries people can accomplish mutuality of perspectives regarding the other participants, their goals and purposes, the resources available to achieve their work and communicative aims. In other words, they share the same environment in which they can see the same people and objects, recognising their availability in the interaction space. They also have pre-conditions for establishing reciprocity of perspectives, that is, they have expectations of individual contributions to the joint activity and achieve a degree of awareness and responsiveness that help them recognise appropriate and meaningful action in the social ‘space’ that they jointly create through interaction.

To capture the complexity of these relationships, and the need to cover a broader range of communication phenomena than those covered by other studies of human communication (cf. Clark op.cit., Rogers op.cit., Hindmarsh op.cit. for example), we have focused our work on different degrees of distance between people in an interaction space. In our context the distance is not only spatial, but also organisational and social. The aim was to take account of those key themes and issues raised by informants in the empirical studies that related to location independent computing and ubiquitous networking on the one hand, and organisational identity and the creation of communities of practice, on the other.

Guided by these considerations, our analysis is focused on co-action and the common ground whilst taking into account the ‘place’ perspective, that is, shared resources, shared spaces and shared objects in a particular work space. The ‘process’

¹¹ An earlier version of this work has been published in the proceedings of the JSAI-Synsophy workshop on Social Intelligence Design, Japan, 2001, D Rosenberg: “Communicative Aspects of Social Intelligence”.

perspective is also needed to capture the nature of the work tasks, goals and objectives as it shapes the use of space and the resources it provides. The 'people' perspective emphasises the degree of participation and involvement in joint activities and tasks. It is grounded in the place and process aspects which moderate the form that co-action and communication take in a particular situation. These perspectives when integrated in the Human Environment Framework and Model capture the variations in the work context that constrain and/or facilitate the range of assumed organisational and conversational roles and thus shape day-to-day activities in the real-life workplace.

In mediated settings, these perspectives provide the guidance for describing the characteristics of the workspace in terms of its ability to provide effective gatekeepers that control access to people and are constrained by privacy requirements, access to information constrained by confidentiality requirements and interfaces that facilitate varying degrees of participation and sharing which taken altogether distinguish private from privileged from public workspaces.

We thus approach the analysis of empirical data with the hypothesis that the cloister, club and café types of workplace can be described in terms of the above contextual features. The possible configurations of these contextual features that define the three basic types of space also help to define the hybrid spaces that are most common in real life, the 'interlocking' spaces, such as, club in café that can be seen when a small group of people holds an informal meeting in an open-plan office, or cloister in café when an individual puts headphones on in order to distance herself from the surrounding activities.

In this way we expect to improve our understanding of the regularities and uniformities in joint activities in the workplace. Furthermore, based on this understanding we expect to inform workplace design by identifying the key features of human environment that must be preserved in mediated and hybrid cloisters, clubs and cafés. Working within this framework we aim to inform the design of the mobile workplace, when the symbolic nature of people's behaviour is dependent on the information displayed on the computer screen, so that the shared representations of privacy, access, presence and sharing may be incorporated into an effective hybrid workplace.

5.2 Distances in physical and social space

As discussed above, our key analytical stance is that communication and collaboration is best viewed as the interaction between individual and joint actions in the context of shared work tasks and collaborative activities and that action, interaction and context can best be explored through a uniform concept of a shared interaction space.

The main variations in the shared interaction space are illustrated in Figure 2 that shows how, in general terms, the three types of work space, namely, private, privileged and public differ from one another in terms of the opportunities for interaction and in terms of mutual visibility of the individuals occupying the work space. It also shows how a well-designed mediated space enhances these opportunities by making new configurations possible.

Furthermore, the interaction zone matrix can be adapted to capture vary-

ing degrees of privacy in the work context, so that we can examine the implications of variations in the work context. A simplified example can illustrate how spatial, organisational and social distances may guide appropriate behaviour – if members of the same team (social aspect) share the same work space (spatial aspect) and work on the same task (organisational aspect), then the degree of access to people and information is high and the requirement for privacy and confidentiality is low. Thus the presence and the sharing required for effective co-action and communication are also high. At the other extreme, if members of different teams share the same work space but work on different tasks, then they need to create boundaries within the shared work space that will help them to accomplish privacy and confidentiality, reducing the feeling of presence and sharing to the minimum.

Between those extremes, there are variations that seem particularly interesting for the design of a hybrid environment. For example, when members of the same team work on the same task but do not share the same space, which is frequently the context of computer-mediated communication, the requirements for access, presence and sharing are high and the demand is for the mediated setting to provide rich and flexible communication channels that resemble, as closely as technology advances allow, the traditional, co-located workplace.

In contrast, if members of different teams share the same work space and work on the same task, the degree of access to people and information is restricted to the part of the work context that does not conflict with team loyalties. In such a case, mediated settings have the advantage, since boundary controls are easier to establish and maintain when some channels of communication may be switched on and off ‘on demand’ as were. It is in this sense that we can explore the advantages of mediated settings over the co-located ones.

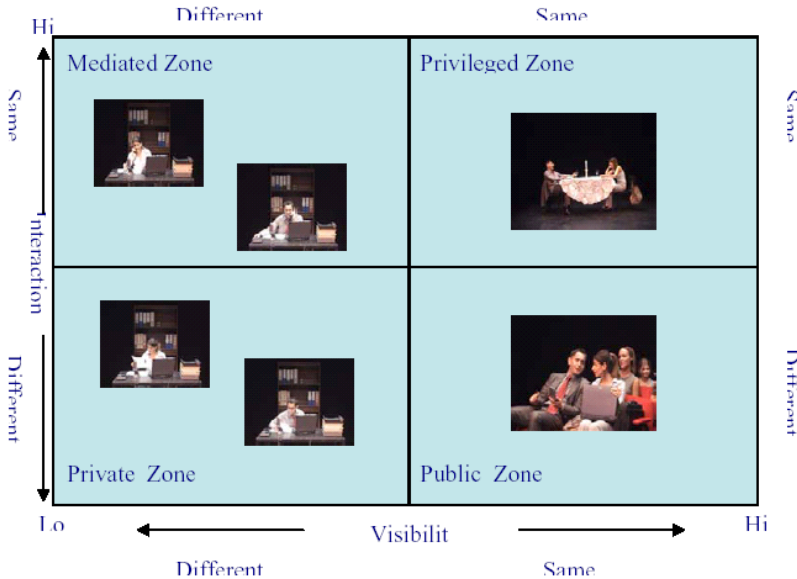


Figure 2 Interaction zone matrix for hybrid workplaces

Thus the initial empirical study of user and workplace requirements leads through a series of iterations and refinement to the formulation of hypotheses that may be validated empirically by means of informants' feedback, or experimentally, when the variations in the context of mediated work settings have to be specified in advance of the design and implementation of the 'hybrid', technology-enabled workplace. The practical requirements of workplace and technology design have encouraged us to cross the methodological boundaries of distinct traditions in the studies of human communication, and this is the ongoing concern discussed in the section that follows.

6. Theory and practice working together

For the purposes of this study, we focus on issues of boundary control that is necessary for individuals to adapt their actions to the collective norms. In terms of space, we distinguish between private, privileged and public spaces for co-action and communication. Such spaces regulate access to people, bearing in mind their need for varying degrees of privacy, and access to information bearing in mind different degrees of confidentiality, where access to particular items is often restricted to a certain category of employee. Access to people and information regulated by constraints imposed by requirements for privacy and confidentiality thus characterises the nature and the extent of connectivity in the workplace.

However, in order to create and maintain conditions for individual and joint co-action, it is not enough to design connectivity into the workplace. Such, profoundly social dependencies, demand that the workplace provides appropriate conditions for interactivity, that is, to design spaces that allow proximity of its occupants, that offer them a sense of permanence and that support their productivity. It is only through proximity, permanence and productivity of the workplace that people are empowered to create trust, friendships and partnerships based on trust. In addition, as has been recognised in the multi-disciplinary literature concerned with work culture (cf. Foley, 2004), organisational identity of a company's workforce is a pre-condition for them having the sense of belonging to their organisation, community and culture.

Thus the key design issues for the workplace of the future can be summarised as connectivity and interactivity. Connectivity refers to access to people and information, moderated by facilities for boundary control that regulate different degrees of privacy and confidentiality. Interactivity refers to the affordances in the workplace that enable people to regulate the nature and the extent of sharing of its resources, so that they can create trust and partnership through natural forms of interaction.

The key research issues in this context focus on connectivity and interactivity of a work space as the means for establishing communication channels that are flexible and adaptable to the requirements of particular, situated, interactions. Sufficient visibility between participants is required and also sufficient awareness on the part of the participants of their environment, physical or mediated. Essentially, research issues concern the relationship between individual and joint action that underpins the way people work together, that is, how co-action is accomplished, through interaction, to solve shared problems, how relationships based on trust

and personal contact are created and how people make use of the affordances in the workplace to make the integration of individual and joint actions more effective.

To address these research issues we developed a repertoire of methods and techniques that allowed us, in the first instance, to discover key features of physical, traditional, workplace that supports effective communication and collaboration. Since such methods have been developed to capture the full complexity of observable patterns of interaction and behaviour, they were by necessity limited to the investigation of the existing workplace in the organisations of our partners. However, we need to extend our 'toolkit' to be able to project our understanding of the workplace of today to shed light on the connectivity and interactivity in the workplace of the future where information and communication technologies are an integral part.

Empirical studies of introduction of technologies into the real-life workplace bring to light the profound changes in the structure of our societies in a very short time. Indeed, there was a warning against the unqualified acceptance of rapid technological change before a knowledge base had developed that captures experiences of individuals and fosters information and knowledge sharing between and within the community. Our interpretative analysis of office-based employees in a number of organisations suggesting that inappropriate implementation of technology disorients, invades, isolates and ultimately separates individuals from the conditions of their work. At the same time, the analysis also suggests that people at work are establishing a prevailing knowledge base that provides a range of new opportunities for not only co-action and communication, but also increasing mobility within and without the workplace, ultimately raising employment prospects, and nurturing a greater sense of self-sufficiency, accountability and responsibility. Novel forms of interaction space, that is, physical space enhanced with communications technologies, make it possible for the boundaries that determine organisational and social co-presence to become invisible.

Workplace of the future will incorporate technologies as an integrated component that ensures connectivity and interactivity of the mobile workplace. It should be emphasized at this point that usability studies of relevant technologies suggest that the technology should not be regarded as replacing essential features of the physical workplace, but enhancing the workplace by providing additional facilities for mediated collaboration and communication (cf. Rosenberg et.al. 2004). This means that we investigate natural interaction in the workplace with the view to augmenting the facilities and ultimately enhancing the experience of collaborative work.

Taking into account the interplay between the physical and the social space where people communicate and collaborate, the Interaction Space Approach aims to explain how communication serves the purpose of making work performance more effective and how conversations are organised to facilitate effective teamwork.

In our approach, we have followed an empirical method for the collection and analysis of the data which involves an examination of the interview text and its context, in other words - what the informant says explicitly, and what he or she means. It also considers discourse and values, in other words how the informant engages with others and why they do what we observe them to be doing. Moreover,

in this kind of approach it is important to interpret their words in relation to the researcher's observations.

The main advantage of using an empirical study of roles and responsibilities in real settings is that it offers a range of methods and techniques to describe what people say and do in particular situations. These methods are especially suitable for bringing to light the implicit constraints that underpin their talk and behaviour. The constraints can be related to their knowledge of the language and the way it is used, the subject matter of a particular conversation, the social norms and patterns of behaviour. In sum, these constraints are about "what members of a community need to know in order to behave appropriately in culturally significant settings" (Saville-Troike, 1972). Within the research projects described above, we use these methods to bring to light the implicit constraints and preferences that underpin and drive the work context. In addition, our aim has been to illustrate how these constraints lead to variations in the work context, which ultimately influence how individuals create and maintain conditions for co-action and communication in a workplace that enables permanence, proximity and productivity of shared work.

Last, but not least, we conclude that the requirements of the hybrid work environments that will characterise the workplace of the future for technology-based resources are not to mimic the contextual features of the traditional co-located workplace, but to enhance it. In other words, mediated work settings are, and should be different, as the main benefit they offer is to increase the range of possibilities for effective co-action and communication. To accomplish this, we may need to establish closer collaboration with 'practitioners' concerned with the design of the workplace and the technology that will enhance it, and we hope that this work is a step in the right direction.

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