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Artefact Ecologies: Supporting Embodied Meeting Practices with Distance Access

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Abstract. Frameworks such as activity theory, distributed cognition and structuration theory, amongst others, have shown that detailed study of contextual settings where users work (or live) can help the design of interactive systems. However, these frameworks do not adequately focus on accounting for the materiality (and embodiment) of the contextual settings. Within the IST-EU funded AMIDA project (Augmented Multiparty Interaction with Distance Access) we are looking into supporting meeting practices with distance access. Meetings are inherently embodied in everyday work life and that material artefacts associated with meeting practices play a critical role in their formation. Our eventual goal is to develop a deeper understanding of the dynamic and embodied nature of meeting practices and designing technologies to support these. In this paper we introduce the notion of "artefact ecologies" as a conceptual base for understanding embodied meeting practices with distance access. Artefact ecologies refer to a system consisting of different digital and physical artefacts, people, their work practices and values and lays emphasis on the role artefacts play in embodiment, work coordination and supporting remote awareness. In the end we layout our plans for designing technologies for supporting embodied meeting practices within the AMIDA project.

Keywords. Artefacts, Embodied Meeting Practice, Artefact Ecology, Awareness.

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1. Introduction

Meetings are described as the 'most pervasive knowledge event' in working life [22]. They play a central role in collaborative decision making in work organizations. Meetings do not exist in isolation of work practices but are the integral and critical part of organizations. Technologies to support different meeting activities have mainly focused on the conversation paradigm of face-to-face interaction between meeting participants. However, meetings are more than having conversations – involving talking and listening. They are fundamentally embodied and involve wide range of physical activities like writing meeting notes, drawing, demonstrating, and so on, involving several digital and physical artefacts such as computer (laptop), projector, screen, pen, paper, and many others. Especially, in case of designers, architects and engineers meetings may involve wider embodied activities with several specialized artefacts. In short, meeting practices consist of a complex and dynamic eco-system.

Goals and agenda of meetings are more or less predefined but the process and contents of meetings are largely variable and almost unpredictable. Several approaches have been developed to model meetings focusing on, for example, turn taking, floor management, dominance, and presence [18]. We believe that meeting practices can also be conceptualized based on the usage and manipulation of different artefacts associated to the meetings. We use the term artefacts to commonly refer to different physical and digital objects used to support meeting practices. Normally, the artefacts and concepts brought into the meetings evolve as the results of meeting and eventually materialize into work activities [22]. These artefacts 'carry' important information and details that could help when making sense of the meeting contents. Of course, the value and usefulness of this information vary amongst different artefacts. As an ambiguous indication, for example, some paper documents used during meetings are clearly 'personal' because of their positioning, whereas others are pushed more towards the center and angles to make them available to all, yet still with a level of personal control. And as a concrete indication, Ramduny-Ellis et al. [19] showed that meeting notes could provide indications about what happened during meetings, what was communicated to others, how the future

coordination of activity would follow and it could act as a locus for political power and conflict. The use of artefacts can also help coordinate work by triggering the participants of the meeting. See figure-1 as an illustration of physical activities and use of different artefacts, confirming its embodied nature.

Even though the settings that people work in are becoming more and more digital, our bodies and minds are naturally designed to interact with the physical. One of the central aims behind designing tangible and embedded interfaces is to allow users to interact with them in a natural way that is grounded in everyday mundane experiences. This poses two main challenges for designers. First is to understand what ways the users naturally interact in their mundane experiences. And the second is to introduce a technology that supports (or improves) their experience. There is a decent amount of literature on tangible interfaces accounting for their architecture [24] and design concepts [5, 14], however, the domain of tangible and embedded systems lacks specialized design methodologies and frameworks.

In the case of supporting meeting practices, we believe that it is very important to first develop a conceptual base and a structured approach towards designing embodied meeting support with distance access. This paper provides conceptual bases for developing an approach to support meeting practices. We introduce a notion of 'artefact ecologies' as a conceptual approach to understand embodied meeting practices. Artefact ecologies refer to a system consisting of different digital and physical artefacts, people, their work practices and values and emphasis on the role artefacts play in embodiment, work coordination and supporting remote awareness. It helps understanding the three important issues of remote meeting participation: the dynamics and complexity of meeting practices, embodied aspects of meetings and supporting awareness with distant participants.

In the rest of the paper, we first provide a short note on the AMIDA project and a brief survey of research supporting remote participations. Then we introduce the notion of artefact ecologies and its usefulness. We also discuss some drawbacks of other conceptual approaches and show how artefact ecologies can be a useful approach. In the end, we draw out some initial plans for further research on the AMIDA project.

2. Background

AMIDA project is a successor of the AMI project [1] (Augmented Multiparty Interaction) with an addition to support distance access. A specific focus of AMIDA is to provide remote participation support for meeting practices and hence to allow computer mediated communications (CMC). The transition from AMI to AMIDA requires supporting additional issues such as awareness, presence, remote coordination, and many other related aspects.

The earlier technologies that were used to convey remote awareness through closely coupled audio-video links between offices were termed 'media spaces' [3, 7, 8]. Their initial use was to connect work between geographically dispersed offices and work environments. The earlier CMC research was preoccupied with supporting mainly the face-to-face interaction models, focusing on *conversations* as a fundamental resource of mediation. The prime motivation behind this preoccupation was the desire to forge technologies that can support cooperative work over distance, modeled on the conversation paradigm. The main expected benefit of using media spaces was to support productivity in work environments by creating possibilities to engage in task-oriented conversations from a distance and, at the same time, to have a general orientation to the presence and activities of colleagues at the other end.



Figure 1. Illustration of 'embodiment' in different meeting practices (source: AMI portal [1])

In certain multi-party interactions (e.g. in a remote meeting scenario) sometimes direct observations through audio and video links may not be sufficient. In meeting rooms a great amount of knowledge transition happens through different digital or physical artefacts like PPT slides, documents, sticky notes, drawing boards, ‘meeting minutes’, and so on. In a number of cases [19, 21] cooperative work is coordinated and interactions takes place through artefacts rather than by direct face-to-face interaction or by other forms of verbal interaction. Virtually most ethnographic studies [e.g. 12, 13] have reported the importance of physical artefacts in work environments as an important resource of work coordination and knowledge transition. More importantly, the use and disposition of these artefacts in office ecology exposes several hidden and subtle work practices [4].

Some of our previous research has shown that artefacts can be seen as traces, cues and modifications of different activities of distant or co-located interactants [26]. This not only provides feedback to interactants but also triggers new actions on the artefacts. These activities are (partly) recorded in artefacts and this record can be used to coordinate the collaborative work. What an artefact affords can be seen and interpreted differently in different situations. Two thorough studies focusing on the meeting situations emphasize the role of artefacts in coordinated work [19, 21]. They have reported that because of its physical and material properties (content, appearance and disposition) an artefact can serve as a carrier of knowledge and information for coordinative work practices. Additionally, it has also been shown in other works [25] that artefacts may also carry certain symbolic meanings in addition to the functional meanings.

3. Artefact Ecologies – A Conceptual Framework

We describe the term artefact ecologies to refer to a system consisting of different digital and physical artefacts, people, their work practices and values and their emerging and dynamic relationships. The concept of ecology has its base in biology and is used as a mean to illustrate relations between an organism and the surrounding environment.

Biological ecologies have several characteristics:

- *Heterogeneity of objects and organisms* – different organisms together make up an ecology, along with the physical environment (e.g. pools, rocks).
- *Mutual interaction* – these organisms in various ways interact (e.g. eating one another, competing for food stuffs, altering physical environment).
- *Emergence* – the observed phenomena do arise not only through central coordination, indeed organisms need not cooperate and frequently compete or conflict.
- *Adaptivity* – the organisms change in response to changes in the environment, which themselves may be the result of natural causes (e.g. erosion, catastrophic

flood, volcanic action), extraterrestrial causes (e.g. asteroid strikes, solar activity), or industrialization (e.g. pollution, despoliation, climate change).

- *Co-adaptivity* – the organisms also change in response to other organisms changes, and furthermore may change the environment itself requiring adaptations to that

The first three of these largely relate to activity within the timescale of the lives of individual organisms (typically days, weeks, months, tens of years), while the latter two relate to timescales of species development (tens to tens of thousands of years).

Because humans are reflective and not merely reactive creatures, the timescales and the nature of these processes are richer in some ways than biological ecologies, but it follows a similar pattern. Some of the aspects that could be observed in a short visit to a working environment will be discussed in section 3.2. Others are about the way that environment and the artefacts within it alter over time both shaping and being shaped by the people within it.

3.1 Dynamics of Artefacts and Meanings

To give an overall picture of artefact ecologies, we inevitably have to take into account a network of social and ecological effects including many that change the nature of the available artefacts and what is afforded by them.

Figure 2 captures some of these interactions. The cycle (1) shows the simple pattern of artefacts having affordances [9] perceived by a user (or in collaborative situations group of users) who then act on them. However, performing an action changes the situation (2), physically, cognitively and culturally: for example a user may become aware of more possibilities as a result of using an artefact.

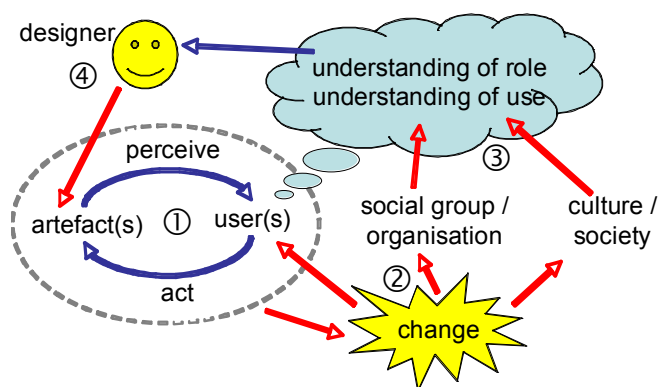


Figure 2. The dynamics and evolution of artefact ecologies

In particular, the perception and acting out of affordances may lead to reflection (3) on the artefacts, their uses (potential actions) and people's roles (constraints upon actions). Once users are aware of this their perceived affordances change also.

Furthermore, knowledge of the potentialities of artefacts and materials may lead (4) to modifications of artefacts, design of new artefacts (e.g. tools), which then change the environment both by their own existence and because of the changed affordance of pre-existing objects (e.g. a round stone affords building once you have tools to dress it). This cycle of change leading to modifications of artefacts is central to some of the notions of Ilyenkov [15] as highlighted by Phil Turner's work on affordances [23]. In particular Ilyenkov sees the creation of physical artefacts and tools as embodying practices of a community, claiming that the artefacts, that we use, embody cultural norms and values. (For example, while not an example Ilyenkov would have been able to use, George Orwell's novel 1984 describes a fictional language called Newspeak, which constrains the English language to only a limited set of acceptable topics – thus representing the socio-cultural effects of a totalitarian regime in a cognitive artefact.)

From this discussion, and explicit in Figure 2 are the three rough levels of artefact affordance:

- (i) single user,
- (ii) organization (work-group or community of practice) and
- (iii) culture / society.

We say that this is a rough categorization as once we get beyond a single user in isolation (which never happens), there is a continuum of effects. Given this caveat, at each of these levels we can see effects of learning and change. At level 1, users build their knowledge of what is possible through action and reflection, but in addition may become more skilled and thus increase the action possibilities: for example, a unicycle does not afford movement (except downwards) unless you have sufficient skill. At level 2, ethnographies have repeatedly shown us the importance of overhearing or overseeing other people's activities [11] and the way we shape our actions for other people's overseeing. So as we act we influence others, and they learn about possibilities for action. In addition we may explicitly talk about action possibilities and train others in skills. Finally at level 3 cultural understandings (e.g. the light switch) influence perceived affordances and norms and roles may alter what people feel is possible or alternatively engender rebellion.

Furthermore, as noted, the actions or activities afforded by an artefact(s) may be about what actions can be performed with respect to the others and this may vary from ad hoc collaboration (a stretcher affords carrying by two people) that is closest to level 1, to higher level effects. At level 2 we might say that a mobile phone affords communication, but only if a group of people all possess one, or at level 3 that stones afford building into pyramids, but only by a society of a particular level of sophistication and political type.

The principle difference between levels 2 and 3 is in extent: level 3 effects are long term and typically cover all one's interactions and experience, whereas at level 2 interactions

may change more rapidly. Normally, level 2 has a tangible 'boundary', e.g. an organization, office-group. Even when new members come in or old members leave and working practices change, the affordances remain specific to that organization or working group. On the other hand, at level 3, knowledge about artefacts is gathered from birth or learnt over time. However, as we have mentioned the true picture is more complex, for example, a mediaeval guild had long term effect on the development of various crafts and their toolsets.

3.2 Artefact Ecologies for Embodied Meeting Practices with Distance Access

In case of different meeting practices, there is a complex set of interactions between different (distributed) artefacts and participants, heavily affecting their meeting practices and values of work and construction and re-constructions of meeting information and contents. The notion of artefact ecology offers a set of analytical properties of artefacts that emerge from the interaction between participants and artefacts in different situations. When technological artefacts (e.g. tangible or embedded interfaces) are used as 'shared' tools [20] for communication between deferent remote meeting participants, the notion of artefact ecologies can be used as an approach that could help designers to support embodiment, remote awareness and to coordinate meeting practices.

Embodiment. Embodiment is an important aspect of meeting scenarios. The physicality of the mundane artefacts used in meeting practices (with its spatial, structural and semantic representations) can lead to some valuable conclusions about the context in which the participants interact with each other. In addition to the representational issues of artefacts, the transformation of those artefacts used in the conversation can also provide the details of the dynamics and the temporal aspects of meeting practices. Artefacts allow participants to use their bodily skills and their familiarity of the real world objects. The use of computational artefacts makes the computation manifest to users in the world in the same way as we encounter other phenomena [6]. This allows the computing artefacts fit more naturally with the everyday world and as a way of enriching people's experiences with the physical.

Awareness. It has been regularly argued in the CSCW literature that contextual awareness such as awareness of colleagues and their activities is essential for accomplishing coordinated tasks. Bly [2] has argued that the level of awareness can be improved if a CMC environment allows representation and transformation of the artefacts – used as a communication tool. For representing the visual information about awareness (be it explicit or implicit), it has been argued that visual information of artefacts used for communication is more valuable than the person involved in it [27]. The use of artefacts in this way is sometimes referred to as the 'common artefacts' [20], representing the shared context and shared experience of the artefacts. The use of the common artefacts provides some level of predictability in the awareness information.

Meeting practices. Because of their pervasive and dynamic nature, the overall meeting practices can not be easily predicted, e.g. participant can behave differently, the contents and the topics of discussion may also drift. In remote meeting scenarios, artefacts could allow a level of predictability with its specific capabilities of representations and transformations. Artefacts could help in coordinating meetings by, for example, managing the turn-taking and floor usage amongst the participants. It may also be possible that use of artefacts (being a source of indirect communication) may provide an overall indication about meeting information, i.e. as an overview. For example, in [26] we showed that a large screen display as an artefact situated in the staff room provided an indication of the overall activity level of an academic department and allowed staff-members to adjust their working practice.

4. Related Work on Conceptual Frameworks

Conceptual frameworks such as activity theory, distributed cognition and structuration theory have been widely used to understand the context of users' work (or non-work) environment in the CSCW community. However, these frameworks do not adequately focus on accounting for the materiality (and embodiment) of the contextual settings [21]. We will not make a detailed comparison of the notion of artefact ecologies with these frameworks but provide a brief review of their lack of support for embodiment and materiality.

As an intellectual tradition and as a conceptual framework, activity theory [17] does not explicitly distinguish the material artefacts from immaterial. To activity theorists like Kuutti [16], as long as a tangible, less-tangible or even intangible things that can be shared for manipulation and transformation by the participants of the activity, these things can be called artefacts. This treatment makes it difficult to address the role of material artefacts in work systematically. This de-materialization of the concept of artefacts has been continued uncritically in the subsequent activity theory tradition. As opposed to activity theory, however, in distributed cognition Hutchins [28] pays detailed attention to trajectories of action 'distributed' over actors and artefacts in what he terms 'a system of distributed cognition.' In doing so, Hutchins directs attention to the specific format of the artefact and its role in human action. Hutchins does it directly, by conceiving of artefacts merely as vehicles of so-called 'representations' on par with 'internal memories'. Similarly, structuration theory [10] also falls short in addressing the material aspects of interaction. The structuration theory focuses on human-human interactions and shows that through communications, using power and giving sanctions, we apply social structures in practice. Social structures are the central elements of discussion and the use of artefacts and other embodiment aspects are not given proper attention in the structuration theory. It is also important to mention J.J. Gibson's [9] contribution in ecological psychology. He termed the concept of affordance as the action possibilities offered by

an artefact. Gibson's notion of affordance comes very close to artefact ecology because of its focus on the compatibility between human organism and his environment but it lacks greatly in other socio-cultural aspects.

Artefact ecology as a conceptual framework deals with both the material and the immaterial aspects. It is up to the designers and situations that they are designing for whether to utilize material aspects such as representing the details of different activities, physical presence, manipulations of object through shared artefacts or utilize immaterial aspects (equally important in meeting processes) such as dominance, frustration, acceptance and so on.

5. Future Work

This paper describes an initial conceptual base for designing embodied support for distance meeting practices. The notion artefact ecologies does not have the maturity of frameworks such as activity theory, distributed cognition or structuration theory; neither does it have practical evidence. However, it does offer some steps towards a richer framework that fully engages with materiality.

In the AMIDA project we aim to use artefact ecologies as a starting framework to conceptualize the issue of awareness, meeting practices and embodiment. AMIDA focuses on the 'design meetings' – involving UI designers, industrial designers, project managers and domain experts, where one or more of the participants is remotely involved in the meeting. As a first step towards it, we have setup an ethnographic investigation utilizing interviews and focus groups of professionals. In addition we aim to make use of video observations of professionals involved in the real-world design projects. The aim of our ethnographic investigation is to understand professionals' current meeting practices, tools and object used and associated with meetings and the embodiment issues. The eventual aim of the project is to provide technological support to better facilitate remote meeting practices.

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