Artifact-based Coordination in Multimedia Production

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Abstract. This paper tries to understand different settings for coordination depending on interdependencies between activities carried out by team members. By applying coordination theories and investigating real work settings in multimedia production companies, we introduce the concept of *artifact-based coordination*. It is defined as a kind of coordination in organizations, which is mainly initiated, handled and negotiated by means of artifacts. Artifacts are permanent symbolic constructs that act as mediators of the coordination. They are used to clarify ambiguities and to settle disputes. They mediate articulation work by acting as an intermediary with a specific material format between actors. Artifacts can be of different types like specialized, material, visual, coordinative, common and multilayered. The artifact-centred view to coordinative work practices helps to clarify dependencies, structures and dynamics in organizations around a design project.

1 Introduction

Coordination can first be studied applying theories and concepts [19] that show us "how coordination can occur in diverse kinds of systems" [7, p.88]. There are several ways to achieve this. One of them is to investigate work practices by means of ethnographic studies that was and is a very important method applied in CSCW research [1] [9] [3]. At the same time, we need to ask the question how information and communication technologies change the ways we work together. If we want to design systems to support cooperative practices we need to understand what actors do and why they do certain things in a certain way.

The research literature identifies the following characteristics of work processes in multimedia companies: the iterative character of the design process, the multiplicity and the special role of representations (storyboards, mock-ups, prototypes etc.), the lack of design methods (in comparison to software engineering) and best practice examples, the cooperative character of the design process and the relevance of intensional networks and strategic partnerships. In our case studies in multimedia production teams[1]

[1] Our study was conducted as part of the research project "Systemic Integration of Production and Services. Case Studies in the Software and Multimedia Industries", in cooperation with the Brandenburg University of Technology Cottbus and DJI Munich (2001-2003). The descriptions of the use cases included in this paper are partly based on [18].

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we could observe most of these characteristics. At the same time we identified interesting differences in work practices and similarities in coordination work.

The work processes of *Webcom*, which is a small commerce-oriented company with eight employees, are organized in a rather straight forward manner. The company's managing director (MD) puts a lot of effort into standardizing processes in order to keep the costs low. He sets deadlines for his staff and controls the intermediate results. Visualizations play a large role in developing and communicating a design concept, in particular between web and graphic designers. Most of the design elements (graphic elements used in web pages like colors, logos, fonts, lines etc.) and ideas about structure and navigation of a web site are reused in other projects.

The task of *Telecom*, which is a development team of four designers in an international telecommunications company, had been loosely defined as designing and developing innovative products and services by using the very newest technologies with the degree of innovation and the speed of the design and development being considered the main success factors.

The main product of *Archcom* is an Internet forum for contemporary architecture. Its manager is an architect with a strong interest and advanced skills in multimedia production and use. He, in parallel, works on small architectural design and building projects. The Internet project is carried out by a team of four. The Flash animation, which is a part of the product, is designed and implemented by two external graphic designers.

Multimedia production is an intensively cooperative endeavour. There is a need to arrange collaborations dynamically among both, internal and external, professionals. Coordination of several parallel activities is a demanding task – especially for the coordinator or project manager. Keeping deadlines and customers' requirements in mind and using companies' human and non-human resources effectively call for sophisticated coordination processes which might be supported by computer systems or other types of mechanisms.

To illustrate differences and similarities of coordination work in our cases we analyze in the next section the cooperation processes in more detail before we describe different types of artifacts we could find in our studies in Section 3 and introduce the concept of artifact-based coordination in Section 4.

2 Coordination Work in Our Cases

In this section, we will briefly present some interesting coordination work we observed in our ethnographic case studies.

2.1 Controlled Individual Work

People simultaneously working on three to four projects is a constellation that is typical of small multimedia companies, as can be seen in the *Webcom* example. Because of the limited number of employees this is practically a necessity. Small teams are formed for each project. This means that information about ongoing projects and the progress status are transparent to all any time.

In *Webcom*, most of the work is carried out individually, at times controlled intensively. For MD the development of process and temporal structures is crucial for being able to manage the progress and quality of the work. He tries to set and closely monitor deadlines, not only within his internal team but also with external professionals. He frequently carries out reviews checking the status, quality and quantity of the work. He prefers to have his co-workers present in the office in order to be able to communicate with them personally. He for example checks the work-in-progress directly on people's screen. Feedback or instructions for modifications are preferably communicated face to face. This is a case of particularly dense cooperation, most of it carried out in front of the computer screen.

The MD's aim is not to undermine the routine procedures in a project. Any contingencies occurring during the design process must immediately be kept under control to avoid any increase in the project costs. This is why we talk her of controlled improvisation.

Between the design meetings all team members work individually on their tasks. E-mail is an important communication medium and used a lot to give feedback to colleagues about their work. Some of these feedback messages are very detailed.

2.2 Cooperative Development

Fig. 1. Cooperative work taking place in front of one's computer screen (*Telecom*).

In *Telecom* most of the design work is carried out in the team. The team members come from different disciplines (graphic designer, software developer, system analyst and project manager (M1)) and each of them has a crucial role and responsibility for all activities. Although their communication is rather chaotic, they are well-organized, always present in the same room and involved in all decisions – no matter whether technical, strategic or organizational. For M1 "the consensus is the product". There is no hierarchy in the team. To have fun while working is as important as to be open to critique and discussion and act as a competent member of the team. The most important thing is that the members participate actively in the design process (Figure 1).

This small team works in isolation from the rest of the department, not only locally. They talk about themselves as a "garage company". Their work is not accepted and

appreciated by the large software engineering team within the company from which they split off. One reason for this is the difference in style and working culture of both teams.

2.3 Multidisciplinary Teamwork

The most salient observation in *Archcom* regards the highly developed communication culture. The weekly jour fix meetings are not only used for communicating but for intense cooperation. In these meetings it may occur that no one talks for a relatively long period of time because all are busy with thinking about a problem or working on a part of the system or taking notes. Meetings are there for solving problems together, for making design decisions and for planning the next steps.

The project manager has a crucial role in these meetings. It is him who moderates the decision process. This includes in-depth discussion of the benefits and disadvantages of a suggested solution for a technical problem. As an architect he also represents a typical user of the system and he often voices the user perspective in the decision process.

The central role of the jour fix meetings is mirrored in the highly detailed and thorough meeting minutes that are produced. They allow team members follow all decisions taken about the functionality and user interface of the system, about changes and enhancements of the underlying database model, about modifications of the web pages, about the business logic, about open questions and the responsibilities of team members for different tasks.

2.4 Coordination with Partners

In multimedia production, coordination is not only an important issue in the company, but also in cooperation with partners. Several forms of cooperation can be distinguished in cooperation networks: cooperation with specialists for e.g. video processing, journalism, film making, graphic design, comics and music; contracting out e.g. maintenance or programming activities; mergers, joint ventures, strategic partnerships; cooperation in the Internet by means of newsgroups or mailing lists.

Personal networks are very fundamental for multimedia production. Nardi et al. analyzed the relevance of what they call ‘intensional networks’ in several case studies in multimedia production companies [8]:

> “We will argue that it is increasingly common for workers to replace the organizational backdrop and predetermined roles of old style corporate working with their own assemblages of people who come together to collaborate for short or long periods. These assemblages are recruited to meet the needs of the current particular work project. Once joint work is completed, the network has some persistence: the shared experience of the joint work serves to establish relationships that may form the basis for future joint work” [8][p.207].

To maintain such networks – to remember the competences, roles, work styles, preferences and communication habits of each person and to activate previous contacts in a

reasonable period of time – requires work and particular skills, argue Nardi et al. [8]. The MD in *Webcom* and the architect in *Archcom* are good examples of people who have built a large intensional network which they activate regularly in their projects.

In the next section we will describe some artifacts we could identify in work practices we observed. We will focus on their role of supporting coordination activities.

3 Artifacts Used in Work Practices

An *artifact* is a permanent symbolic construct and plays a very important role in the coordination of cooperative work. Symbolic artifacts act as mediators of coordination. They are used to clarify ambiguities and to settle disputes. They mediate articulation work by acting as an intermediary with a specific material format between actors. For Kuutti "instruments, signs, procedures, machines, methods, laws, forms of work organization" are examples of artifacts [5, p.26]. Furthermore "an object can be a material thing, but it can also be less tangible (such as a plan) or totally intangible (such as a common idea) as long as it can be shared for manipulation and transformation by the participants of the activity" [5, p.27].

In a usual work environment actors interact through several artifacts. Where an artifact is placed, when it is accessed, by whom it is modified, what the exact modifications are and so on are important issues for coordination in a group.

In our cases, we find complex task interdependencies. To articulate distributed activities carried out in the context of several conventions and protocols *specialized artifacts* are needed [11, p.162]. Specialized artifacts like time tables, schedules, catalogues, classification schemes for large repositories etc. help reduce the complexity of articulation work and alleviate the need for ad hoc deliberation and negotiation.

There are *material artifacts* accessible to all involved in a shared work process [14]. The location of material artifacts includes some relevant information. Some of the actors can probably make sense of it and some others not. One can also see the history on a material artifact, the history of past work as well as the contributions of different actors. Many other authors have also discussed the materiality of artifacts by using the concept of affordances [4] or by talking about the immutability of inscriptions on paper and their mobility [6].

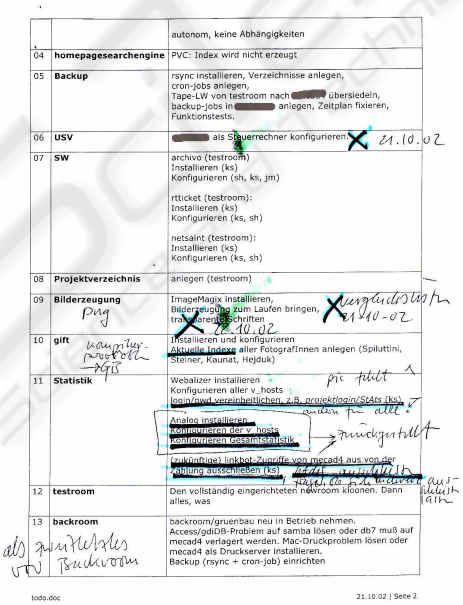
When material artifacts have a coordinative role in carrying out work practices, they are called *coordinative artifacts*. In this sense they are communication objects and persuasive [20]. They help actors in several ways in their daily work: They create a common understanding of a design idea or task. They enable talking about a design in a rich way. They remind design principles, approaches and methods applied, questions that are still open. They also help keeping track of activities and materials [14]. Some design artifacts normally used for coordination purposes contain work plans. They include work to do, project phases, how to proceed in a specific project phase, material to collect or create which is necessary to represent the design, metaphors to enable talking about the design idea, methods defining rules and conventions within the work group, illustrations like sketches, images or photos to explain the design idea, references to material to look for, names of actors responsible for certain tasks. As boundary objects [16]

[17] coordinative design artifacts are accessed and modified by all responsible actors. They enable crossing organizational and professional boundaries many times.

All design decisions made in a project can be recorded and available in a *common design artifact*. It is very usual that actors add annotations to artifacts they use by circling certain areas, adding notes, marking a certain part with a marker or with a post-it including e.g. additional instructions. This type of annotations make artifacts multilayered. *Multilayered artifacts* "facilitate coordination between activities (and the people who are responsible for them). They, for instance, provide a collective or individual space for experimentation and change" [14, p.10]. That implies that artifacts are interrelated to work activites, i.e. actors produce, read, annotate, modify, check, evaluate, communicate and delete artifacts constantly in their work environment.

There are several types of coordinative artifacts [13, p.7]: *Traces* indicate aspects of past activities of coordinating actors. *Templates* specify properties of the result of individual contributions, like product standards, drawings, style sheets etc. *Maps* specify interdependencies of tasks or objects in a cooperative work setting, like organizational charts, classification schemes, taxonomies etc. *Scripts* specify a protocol of interaction in view of task interdependencies in a cooperative work setting, like checklists, productions shedules, kanban systems (card systems to coordinate processes in the production of cabinets) [12], office procedures, bug report forms etc.

The dynamic or static state of all types of coordinative artifacts offers cues and an array of signals to other actors as to the intentions, challenges and problems of the actor carrying out the changes [14].



		autonom, keine Abhängigkeiten
04	**homepagesearchengine**	PVC: Index wird nicht erzeugt
05	**Backup**	rsync installieren, Verzeichnisse anlegen, cron-jobs anlegen, Tape-LW von testroom nach [redacted] übersiedeln, backup-jobs in [redacted] anlegen, Zeitplan fixieren, Funktionstests.
06	**USV**	[redacted] als Steuerrechner konfigurieren. 21.10.02
07	**SW**	archiva (testroom) Installieren (ks) Konfigurieren (sh, ks, jm) rtticket (testroom): Installieren (ks) Konfigurieren (ks, sh) netsaint (testroom): Installieren (ks) Konfigurieren (ks, sh)
08	**Projektverzeichnis**	anlegen (testroom)
09	**Bilderzeugung**	ImageMagix installieren, Bilderzeugung zum Laufen bringen, transparente Schriften
10	**gift**	Installieren und konfigurieren Aktuelle Indexe aller Fotografinnen anlegen (Spiluttini, Steiner, Kaunat, Hejduk)
11	**Statistik**	Webalizer installieren Konfigurieren aller v_hosts login/pwd vereinheitlichen, z.B. projektlogin/STATS (ks) Analog installieren konfigurieren der v_hosts konfigurieren Gesamtstatistik (zukünftige) linkbot-Zugriffe von mecad4 aus von der Zählung ausschließen (ks)
12	**testroom**	Den vollständig eingerichteten newroom klonen. Dann alles, was
13	**backroom**	backroom/gruenbau neu in Betrieb nehmen. Access/gdiDB-Problem auf samba lösen oder db7 muß auf mecad4 verlagert werden. Mac-Druckproblem lösen oder mecad4 als Druckserver installieren. Backup (rsync + cron-job) einrichten

todo.doc 21.10.02 | Seite 2

Fig. 2. An annotated printout of a to-do list in *Archcom*.

Common artifacts are used by more than one actor [10]. They implement the basic functionality to fulfill the requirements [2, p.209]. Their structure and operation are predictable. Actors need to see any time what others are doing and common artifacts give an overview of the cooperative work. They enable implicit communication within a team. They serve as templates representing a limited model of the work to be done by leaving enough space to be filled by their users. If these templates are filled then they become records of the work.

When several actors access the same artifacts these common artifacts must be identified and validated. “When accessing an artifact produced and submitted by somebody else, the actor who may need to retrieve it must be able to establish its particular identity. The item thus has to be named or otherwise identified so that a potential user will know ‘which’ it is” [15, p.19]. In this context conventions to name the items must be defined and communicated. “When accessing an artifact produced by somebody else, the actor retrieving it will also need to somehow assess its relevance, validity, veracity, etc.” [p.19].

In multimedia production as in all design disciplines several *visual artifacts* are created and used for coordination purposes. Most of them are produced as part of discussions, as an integral part of explanations, developments and arguments and they are re-used in follow-up meetings and sometimes annotated with supplements, modifications and comments (Figure 2).

Visualizations support individual and cooperative thinking and organizing. They help to keep the design concept present in the team and to coordinate the work around it. They are used to illustrate the design ideas to different stakeholders in the project, such as the clients, external professionals or partners, convincing them of the design idea and mobilizing their cooperation [14].

Printouts of the web sites may assume yet another role. In *Archcom* we for example observed how printouts were created as part of the design process and annotated with a short description and open questions. These composite visualizations represent a design step together with all issues that need to be resolved in a given period of time. The collection of all printouts served as an important base for planning and coordinating of further activities in the project.

In *Webcom* MD uses several artifacts to control the work-in-progress: the standard format used to write an offer , deadlines kept in a spreadsheet (with responsible persons assigned), the first prototypes created by using Adobe Photoshop and displayed on the screen of the web designer, images an external programmer sends to show the computer game programmed with Flash, emails they send and receive, written guiding themes MD uses to communicate the design idea and related constraints etc. In *Telecom* several artifacts are used simultaneously during meetings: flip charts, PDAs, desktop computers, sketches and notes on papers or computers, lists, MS Word documents, spreadsheets, Web browsers, a wallet, the image of the wallet etc. In *Archcom* the project manager uses a project plan in form of a spreadsheet for the management of deadlines, responsibilities and work flows, which he updates regularly. During the weekly project meetings detailed to-do lists are generated, which afterwards are used to organize the cooperative work within the team. These to-do lists are essential for continuous project work. There are also artifacts like detailed sketches of navigation

and graphic layout of the pages, detailed descriptions of the data for the persistence layer of the system, design representations in different media like sketches on paper, computer-based drawings and lists, storyboards, HTML prototypes.

4 Artifact-based Coordination

Artifacts described in the previous section are manifold. They enable (implicit or explicit) communication between actors cooperating. They mediate the status of work-in-progress and make participants aware of others' activities. They sometimes act as coordinators of work by being communication objects, by creating a common understanding of a task, by enabling talking about tasks, by reminding principles, approaches and methods connected to a task, by keeping track of activities and materials, by hosting work plans and so forth (see Section 3).

So, one can say that artifacts can be used to initiate and establish coordination within a work group. They can be used to exchange data and deal with dependencies between activities. They can be used to exchange work-in-progress implicitely, to support articulation work e.g. by representing work carried out, to point out possible and actual gaps in coordinating dependencies between tasks, to communicate the to-dos explicitely, to assign tasks to persons, to define and refine work to do etc. They can be basically used to coordinate the work. The coordination, that occurs implicitely in work practices when wirk flow is driven by artifacts, can be called *artifact-based coordination*. In artifact-based coordination environments, artifacts help reduce coordination effort, e.g. by making coordination a part of the product to be developed or integrated in the product and therefore by making additional communication or articulation obsolete. An artifact can be accessed any time by all with granted access. There is no need for any additional face-to-face communication. It helps avoid communication gaps and misunderstandings between stakeholders regarding e.g. the devision of labor, because the information is written clearly and is available for all involved.

5 Conclusions

This paper shows that ethnography-based investigations can be used to understand how coordination is actually supported in real work environments. In our study, we illustrated the use of artifacts in multimedia production teams. Here, artifacts used for coordination purposes – even if not intentionally – can be of different types. They can be also composed or atomic, accessed simultaneously or asynchronously, owned by one or many (which requires version and access control mechanisms), visual or textual, material or virtual, common or private. Some artifacts are certainly shared and host several coordination-related data accessed by many. Artifact-based coordination focuses on these common artifacts used in coordinative work practices. It is a first step to implement new frameworks for coordination mechanisms.

The main contribution of this paper is introducing a new attention point in the research of coordination mechanisms, namely common artifacts. This is different than the approaches we can find in the coordination literature so far, like theories or systems based on tasks, interdependencies between tasks, events, constraints, workflows etc. To

establish this new approach to coordination we need new frameworks that analyze and describe properties of artifacts which are of interest from the coordination point of view. These properties can be primary or secondary depending on importance and relevance to the artifact itself and to the use of the artifact in a collaboration context. This study and artifact-focused analysis of coordination work might be used further to think about coordination patterns identified in cooperative work environments.

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