

# Report On Major Themes And Issues Arising From The Workshop

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## Abstract

*The WETICE Workshop on Web-based Infrastructures and Coordination Architectures for Collaborative Enterprises continued two threads of workshops in the WETICE series that were held over the last four years. These workshops addressed the question of how Web techniques can be used to achieve or to improve collaboration within or between organizations, and which coordination mechanisms could be used in such an architecture.*

*The papers presented at the workshop and included in the proceedings contributed to all areas mentioned. They triggered several discussions on the addressed topics. This report present the views expressed and conclusions drawn.*

*The Workshop Chairs voted Alois Ferscha's paper "Workspace Awareness in Mobile Virtual Teams" as the best paper in the workshop.*

## 1 Introduction

The problem area raises several questions of both technical and organizational nature. How can a system enable the participants to support flexible and effective collaboration? Should we concentrate on developing an infrastructure for sharing artifacts (e.g., documents, files, data)? Should we develop a shared language (e.g., XML, RDF) to exchange business information which represents an external representation of the private artifacts? Or will we need a richer communication infrastructure supporting shared virtual spaces (e.g., tuple spaces, MUDs and related Virtual Worlds), where people are "in the system", rather than purely using or sharing the artifacts of a system? Is it important to make the infrastructure seamless, ubiquitous, and unobtrusive, or should it allow user-level access to internal processes, for fine-tuning, efficient access, and instrumentation?

Higher-level mechanisms and procedures have to be considered as well. A collaborative application can reflect the real-world organizations that overlay the system or even become part of the organization itself. The system must therefore both enforce specific organizational rules

(e.g., workflow rules) and facilitate knowledge management and exchange. Thus, the workshop looked not only at collaborative systems, but also at the models and infrastructures needed for enabling human organizations, or hybrid organizations made up of both human and software agents / processes, to effectively interact and cooperate.

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## 2 Workshop

### 2.1 Basic Agreements

Providing user-oriented collaborative systems and infrastructure includes both technology and social issues. As an example, privacy issues within environments include both social issues (what to make private and how to manage the amount of privacy / distribution), and technical ones (how to implement a system with this granularity and level of control).

We need to make this technology useful to humans; it should not just be a set of tools looking for a problem. We therefore need to represent the problems that people have and their goals for collaborative technology. We also need to develop methods to co-evolve and support the correct "concepts of operations", that is, styles of use of the collaborative systems.

Frameworks, methods, and tools are needed that enable the use of each other's collaborative work and results. So far, there is little transfer of tools or results from one project to another.

An infrastructure for collaboration needs to retain different entry levels and modes, so users coming from very different interaction means can still collaborate (e.g., text-based, web, 2D and 3D, mobile, etc.)

We need to define one or more development paths from single user systems to multi-user tools and environments.

Otherwise, collaboration tools will be much more difficult to make popular.

We need to balance standards and standard technology with necessary heterogeneity and methods for allowing specializations.

## 2.2 Quick Poll

We asked our Workshop participants why they want collaborative technologies (21 respondents).

- 8 To support meetings
  - 6 Especially small, personal ones, communities of interest, and spontaneously composed ones
  - 2 Community-oriented, widely distributed services, such as infrastructure for “the good of the community”
- 7 To conduct distributed projects, such as virtual enterprises - Especially knowledge management, identifying resources for and experts for some project, and eventually coordinate with external environment
- 4 To support collaborative manufacturing Sharing both data and process products
- 4 To share data for collaborative authoring
- 2 To share non-verbal skills (e.g., training, telemedicine)

## 2.3 Cooperative Work Dimensions

Figure 1 shows the Cooperative Work Dimensions which represent different kinds of cooperation, and some of the technologies relevant to them. The original of this slide was borrowed from [1].

# 3 Technical and Philosophical Issues for Infrastructure

## 3.1 Purpose

The purpose of the infrastructures that were discussed in this Workshop is to support multi-user interactions at a number of different levels of intimacy. They should allow individuals to control their own time and tools in planning, organisation and execution of their work, business, and private activities, freed from unnecessary time, geographical, media, and device barriers.

We need to characterize, define, and support them, and explain the differences between coordination, collaboration, cooperation, and related concepts. These distinctions

lead to different specifications and uses of the resulting models. There are many different descriptions of the differences, but none has taken a dominating position.

## 3.2 Examples

Games are currently one of the most successful and popular forms of collaborative computing environments, for several reasons.

- Players know their roles and can choose an appropriate level of difficulty.
- There are generally well-defined outcomes (when you're dead, you're dead).
- There is a level of functionality that matches the game story.

The critical mass that is needed for any collaborative system to be effective is relatively easy to get with games. However, the reliability and robustness of these games is adequate for games but not for real life situations, especially for safety-critical systems. Also, creating Collaboration Worlds is harder than “playing” in existing worlds, so most players simply use other people’s game worlds. For us, this means that developing appropriate collaboration environments is (and will remain) much harder than just using them.

Business and Economic applications and models offer a rich history of methods and theory, which certainly make a good start for e-commerce and other distributed business applications, since they provide criteria and hence metrics of success. They are not necessarily appropriate for other applications, such as education, medicine, games, etc.. For each application, these models need to be examined to determine whether they are adequate or not; this applicability does not transfer well.

Security (of information, access, and processes) is a dominating issue and inherently contradicts many of the flexibilities we want to have in collaboration systems. They must handle heterogeneity, flexible starting points for different actors, and recognize and exploit opportunities as they arise. Each of these is a potential security problem, and will need to be addressed as such. The semantics of “just business” is challenging enough for now.

XML is certainly a useful approach, and it is clear that it will happen. It has been pretty useful in examples, because as simple as it is, at least it gets to a first level of agreement. The potential problems are the same as in other languages and arise from misunderstanding of the use for XML for more than syntax. It will not by any means automatically solve semantic integration issues. Different user groups will still have to set up their own conventions for semantic

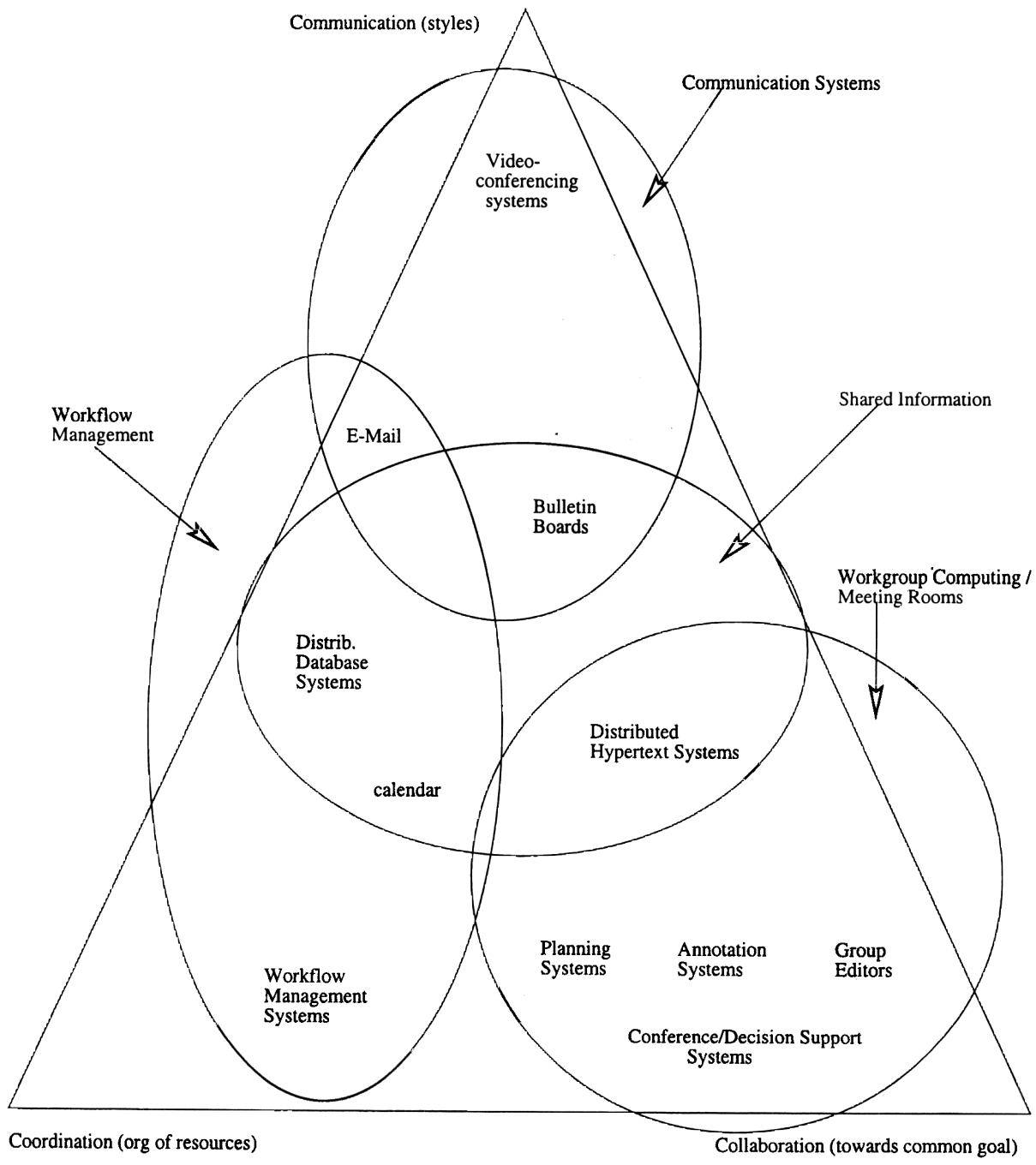


Figure 1: Cooperative Work Dimensions

integration, via an agreed upon mapping of XML-defined syntax into conventional semantic units that are common in the application domain. Many groups are doing this now, and we predict a great deal of difficulty in integration across these domains.

### 3.3 Future Directions

The workshop compiled the following list of issues that lead to research questions in the field of collaboration:

What services and capabilities should be distributed and what should be centralized? What metrics should be developed so we can eventually decide which to do in a given architecture for a given purpose? The user and developer viewpoints of distribution need to be separated, and the corresponding issues for client and server architectures need to be identified. The distribution question interacts with the choice of spatial metaphor that is used, and the emphasis within different implementations of "location" in these architectures.

What is the role of collaboration beyond the box, that is, collaboration infrastructure for mobile, ubiquitous, or wearable computing, and the digital assistants that will provide it? We want an infrastructure for all of our devices and file systems, no matter where or what they are, so that we do not have to manage them all separately and keep them consistent ourselves. We want something like a "Universal Remote Control", that would query the devices within its range, and present a device-specific menu of functions, so that the user need not learn the device details. This level of integration will be hard, especially among different cultures: consider the current difficulties among different standards for just sharing text among different languages.

The individual utility of wireless appliances and other infrastructure services will be greatly increased when they are

- personalized, i.e., user-centered and dynamically adapted to user preferences;
- location-aware, i.e., multimodal and multifunctional according to the environment; and
- time-dependent, i.e., dynamically variable and with timely responses.

We should consider a "pervasive" web infrastructure that links together people in different "modes" (at work, in private, etc.) with devices of different shape / form factor / functionality, at different places (fixed, remote, roaming).

### 3.4 Properties

Observability in several senses is a big issue. Here the group was split on how crucial they considered "mutual

observability" to be as a property of collaborative environments. Not everyone observes the system in the same way at the same time, and these multiple viewpoints are key feature of agents. Even if mutual observability is not emphasized, there are crucial issues of instrumentation of a system, so its developers and users can observe its behavior, for modification and understandability.

Time management issues are crucial to coordination and collaboration - and hard! Time management is needed to organize both causality and observability. It shows up here in e-commerce, manufacturing, telemedicine, games, and meetings. The problem is to find methods to let a distributed system evolve over time in a consistent manner, since such concepts will impact our "user models" that are so necessary in collaboration. Many methods exist for time management in some applications (e.g., for distributed simulation, etc.), but in these collaborative systems, we are combining both virtual and real clock times, and that is much harder than managing either one separately.

One of the difficulties in analyzing collaborative systems is our difficulty in representing what we want to DO collaboratively in a computer mediated environment, and how it fits into our organization or other work environments. We need methods that are flexible, expressive (enough), and analyzable. The Workshop heard some promising formal work on collaborative protocols.

It is clear that whether as protocols, places, or special agents, part of collaboration requires representing social rules and conventions, since we are generally expecting the collaborating entities to be humans. We need to distinguish among the different kinds of constraints (social conventions, coordination constraints, etc.), and among the different degrees of enforcement and style of enforcement of those constraints (e.g., chosen by players, the "physics" of a place, etc.).

Finally, we get to standards, where we have a direct conflict between the variability of human behaviors and the rigidity of computing behaviors. We need to determine what the correct role is for standards, and especially what the correct level of control is. We need to decide when they should be used in this community, how soon we can leverage off the advantages of standard languages, and when we should leave the coordination to the participants. We need to decide what kind of standards are appropriate for what part of the infrastructure: open standards seem much more desirable than proprietary ones. We started in the Workshop a wish list on the characteristics of the kinds of languages we want.

## 4 State of the Art?

We need more roadmaps and better overall visions for collaborative environments and frameworks. They will lead to planning and investment strategies. We need help in mapping problems and uses of collaboration to current and future capabilities, since there is no plan for transitioning to more use of current and future collaborative tools.

We need modeling and studies of the impact of these technologies on workplaces. For example, there are few studies of how technologies impact work styles. We need much more experimentation on how humans use these tools. We need more information models, process models, and much more data.

We need to scale up the size of applications. We are past toy problems, but we are not past small or simple problems. Large collaboration services are being provided in versioning systems, mailing lists, email, chat groups, MUDs, and the web, but all of them address a relatively homogeneous problem, using either post and access style, or explicit distribution to a known list. Neither of these support small groups in personal, specialized, or sophisticated fashion. It is also not yet possible to analyze them.

We need to collaborate ourselves, because of the rising number of devices in use per person. We are building up a body of knowledge by using some common approaches and some somewhat composable approaches. We need to compare these and understand where each provides an essential capability.

The continuing virtualisation of organisational structures in “virtual communities” and “virtual enterprises” is a direct consequence of the availability of new networking technologies and the advanced mobility of people, devices and services. Facing today’s maturing of these and other networking technologies, particularly the wireless Internet, as the fastest growing economic and industrial fields of information technology, it is important to develop new views on how organisational structures, human relationships, responsibility and trust, work and lifestyle can be redefined and manifested, as time, geographic, media and mobility boundaries become less and less important.

We need to develop the understanding to support these views, the methods to understand and model them, and the infrastructure to implement them.

## References

- [1] S. Teufel, C. Sauter, T. Mühlherr, K. Bauknecht, *Computerunterstützung für die Gruppenarbeit*, Addison-Wesley, Bonn 1995 (in German)