Working Group Report on Web-based Infrastructures for Collaborative Enterprises: Ready for a Second Generation?*

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Abstract

This report of the working group summarizes the discussions and the common understanding of the active participants of the workshop. The goal of this workshop was to bring together leading researchers with different scientific backgrounds and different understandings of what the most interesting aspects or problems in the area of collaboration are, and to develop a broadening understanding of what collaboration is about. Of course the workshop did not try to address collaboration per se, but tried to focus on collaboration via the Web and to explore the limits of the current infrastructure in respect to collaboration.

1 Introduction

The following questions have been asked on the WETICE'96 workshop "Web Infrastructure for Collaborative Applications" two years ago.

1. Can the Web serve as an infrastructure for both developing and implementing business applications in a, possibly globally, distributed and collaborative business environment?

2. Can Web-based software be an answer to the challenges that globally operating companies are facing?

It is somewhat surprising that these topics are still of undiminished importance, surprising, because Internet-based technology continues its fast development, and many new approaches and techniques have been proposed in the meantime. But did they succeed?

The basic communication infrastructure needed for collaborative application became available in virtually all enterprises through Web technology. Induced not at least by these rapid developments enterprises are seeking new efficient forms of organizing collaboration and exchanging knowledge within and between enterprises. The demand for collaborative applications is higher than ever.

It seems, however, that both a higher technological layer and a deeper understanding of collaboration in general is missing to exploit the potential of Web technology. This two-folded lack hinders the development of effective collaborative applications.

This year's workshop tackled the problems mentioned above in various ways. The results of our discussions and an outline of an integrative view is given in the following sections.

2 Issues

One very interesting aspect of the workshop was that almost every participant had, at the beginning, a very clear understanding about the key issues related to collaboration. But during the discussions these personal understandings, concepts and models turned out to be vastly incompatible and lead to interesting arguments about what the key issues are. These discussions settled in the following three main groups of issues:

1. *General Issues:*
   - *Lack of Theory:* There is neither a general theory of collaboration nor seems the theoretical coverage of important sub-areas sufficient.
   - *Market Place:* In which kind of environment does collaboration happen, what are the involved products, what are the influences?
   - *Organization:* What kind of organizational units do cooperate, how can/do these adjust in order to ease collaboration, what are the "Spheres of Power"?
2. *Technical Issues:*

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- *Infrastructure:* What kind of Protocols, Tools and Techniques exist, for what kind of collaboration aspects are these (in-)sufficient?
- *Standards:* Emphasis the use of standards to ease information exchange.
- *Simplification:* Ease asynchronous collaboration or make the possibility of asynchronous collaboration a byproduct of work-flow systems.

3. *Social Issues:*

- *Interaction intensity:* During different kinds of collaboration acts, interaction among people is needed in a certain intensity (similar to information richness theory)
- *Kind of Interaction:* People can interchange artifacts (documents, etc.) and they can share presence (people are "in the system").
- *Knowledge extraction* is a key factor for both synchronous and asynchronous collaboration. The first case is similar to the problem of knowledge engineering in expert systems, the latter case resembles the problem of intelligent document retrieval from corporate knowledge pools.
- *Formation of a collaboration culture:* People must learn to contribute knowledge and must be rewarded for their contributions.

The following section briefly summarizes the paper presentations and the subsequent discussions. Some important issues will be identified and observed trade-offs will be pointed out.

3 Identified Trade-Offs

Web Based Group-ware Support for Knowledge Creation and Competitive Advantage

Sipcic described an integration style using a small number of tools, chosen for their individual excellence at particular tasks.

Issue: Integrate available "collaborative" technologies and the Web to enable faster delivery of solutions to the market; Web-technology makes implementation/ integration and dissemination easier.

Trade-off: Integration vs. single solution or integrating commercial off-the-shelf (COTS) tools vs. bespoken solutions.

A Web-based Collaborative Design Modeling Environment

Wallace and Pahng described loose integration among technical models (models may describe organizational aspects of a problem also) – partially hidden models, cooperating via messages (shared, or at least transmitted, artifacts).

Issue: Models and wrappers (e.g. DOME) can be used to integrate proprietary or confidential components. These interfaces allow to make public data available from confidential components.

Trade-off: Data driven vs. process driven integration.

Collaborative Organization Design: A Synergy of Groupware and Web-based Infrastructures and Technology

Ott and Huth described tools and methods to allow collaboration among individuals to design local organizations – uses Web infrastructure to support group-ware. There are tools to help organize teams to particular tasks – also about integration of organizational information across an enterprise.

Issue: There is a need for decentralizing organizational design and integrating it into work-flow management.

Trade-off: Transparency vs. privacy of organizations.

Beyond Web Technology – Lessons Learnt from BSCW

Koch and Appelt described an integration tool that improves access from a standard Web browser to group workspaces. The browser allows asynchronous access for a wide range of users. The functionality is limited due to the chosen restriction to HTML 2.0 (GUI restrictions) and HTTP compliance (no change notification mechanism). Java-based enhancements are already developed but their sole use would restrict availability (not every browser is Java-enabled) and accessibility (robots, search engines).

Issue: Web is already an infrastructure for asynchronous collaboration.

Trade-off: accessibility vs. functionality or "plain Web technology" vs. "advanced" Web programming (JavaScript, Applets).

More than Shared Artifacts: Collaboration via Shared Presence in MUDs

Landauer described the importance of shared presence (MUVEs), in addition to shared artifacts (Web, most group-ware), for collaboration, and pointed out how we must examine ourselves and our behavior in order to understand collaboration. He pointed out that there are important sociological and psychological issues to be considered before we can adequately support humans in collaboration.

Issue: Some types of collaboration require shared presence and not shared artifacts

Trade-off: Having people in the system vs. outside using the system.

Hernals – An Interaction Object Architecture

Mühlbacher proposed a model for shared business objects based on business rules to facilitate interaction among companies. Trusted third-parties can offer value added services by providing an infrastructure for the business objects. The success of such services will depend on the existence of a common understanding/terminology which has to be developed.

Issue: Web opens market chances for new mediators doing core business services.

Issue: The artifacts of business collaboration (contracts, bills, ...) are not owned by a single business partner.

Trade-off: Use of Common (imperfect matching) standards vs. tailored and bespoken interfaces fulfilling all needs.

Enabling Synchronous Joint-Working in Java

Minenko presented a shared Java application development environment putting multi-user actions into existing single-user application environments without the need of rewriting.

Issue: It is possible to enhance existing Web-technology (like Java beans) by multi-user capabilities for synchronous collaboration without modifying the application.

Trade-off: Sharing artifacts synchronously vs. asynchronously.

Trade-off: Re-use of components vs. rewrite shared applications.

Integrating Web and Database Information for Collaboration Through Explicit Meta-data

Morgenstern showed the power and appropriateness of meta-data to integrate Web pages and databases, and proposed three categorization questions for meta-data: structural vs. semantic, aggregate vs. instance, and explicit vs. implicit.

Issue: Meta-data has to be made explicit. More attention on semantics is needed. Heterogenous meta-data confounds collaboration; seek uniformity.

Trade-off: Understandability of published data vs. extra efforts to make semantics more explicit.

MOS → DYX – or: Why should we use XML in collaborative applications

Matthew Fuchs described XML ("Dynamic Young XML") as a tool for interoperability among computer programs ("Messy Old Systems"), other agents, and people. XML allows users to add tags, to display and manipulate tables, to assist in integration of programs with each other, to distribute invocations across an ORB, to provide "equal opportunity" syntax: information in XML is readable by humans and by computers.

Issues: XML has huge potential. XML as a "Lingua Franca" for communication between humans/agents. XML is a basis for various high-level "protocols". Domain-specific languages can (and must) be developed on top of XML to express domain-specific semantics.

Trade-off: Explicit vs. implicit confusion, ie. clarifying the syntax does not automatically provide us with clarified semantics.

4 Conclusion

This last section summarizes some of the final discussion results. The topics mentioned may serve as a starting point for developing new or revised thoughts and solutions. We hope to continue this discussion in a follow-up workshop and, hopefully, via the workshop's Web page.

A collection of some structured thoughts on collaboration (mainly contributed by C. Landauer) may clarify the tackled problem.

1. Why collaborate?
    - *For businesses:* They think that better information integration will help them respond more quickly and effectively to changing market conditions.
    - *For managers:* They think that quickly formed temporary alliances across an organization can be an effective way to build responsive teams.
    - *For model designers:* They think integrated models are needed for global (instead of just local) optimization.
    - *For researchers:* They think that people and models and programs all working together in a common context will discover or invent or improve the answers to many hard questions.
    - *For workers:* They think that resuing knowledge is more efficient than rethinking.

2. Who collaborates? The answer lays in the power-set of the following categories:
   - people
   - information
   - models
   - programs
   - systems
3. How do they collaborate?
   - synchronous / asynchronous
   - artifacts / presence
   - direct / indirect
   - sharing, finding, delivering, presenting, incorporating data / information / knowledge (depending on perspective and definition)

This list is certainly far from being complete, it demonstrates, however, the multitude of aspects which have to be considered when searching for an architectural conception for a general Web-based infrastructure supporting collaboration. Some of these aspects (those the participants considered most important as topics of future research and discussion) will be highlighted in the following.

- Having heard and discussed much about XML, the need was observed to collect XML "success" stories (new and simpler solution to well-known problems, new possibilities, difficulties/restrictions) to allow for an improved assessment of XML's pros and cons.
- Theories of shared artifacts and of shared presence, theories of integration (of tools, techniques, integration itself etc.) should be proposed and discussed to overcome the observed lack of theoretical foundation (which, in turn, hinders the development of a common terminology or, to be more precise, a common understanding of the already used terminology).
- An increasing emphasis on domain knowledge was observed. Enabling easy expression, collection, and usage of domain knowledge seems to be key requirement for successful collaborative applications in a business context.
- More effort has to be put into understanding the trade-off between collaboration and the desire for privacy. This touches the social, organizational *and* technical layers of the "Collaboration Problem Space" (see below).
- Collaboration is more than Web usage, ie. to successfully provide an infrastructure and awareness for collaboration within or among enterprises, the problem space has to be thoroughly analyzed, the requirements have to be understood, and a solution has to be developed. Among the layers that enable this development process, a technical, Web-based infrastructure may be a key success factor – but not the sole solution.
- Managing variability instead of enforcing uniformity may open up an opportunity to deal with the complex social and technical interaction patterns showing up in collaborative processes. However, it is neccessary to understand the ingredients that are necessary for a successful management of variability.
- If the Web and related technologies are used to create bridges between islands of consistency (or spheres of control), this may contribute to the solution of some of the observed problems. Managing variability is about developing and intelligently using such bridges, as well as is maintaining privacy while enabling collaboration. The role of such bridges is depicted in the following figure (based on Vladimir Minenko's hand-drawing). It presents an integrative view of the "Collaboration Problem Space" and can also be interpreted as a vision of a working environment for collaboration, based on established standards, developed infrastructures and an understanding of the underlying / motivating organizational and social needs.

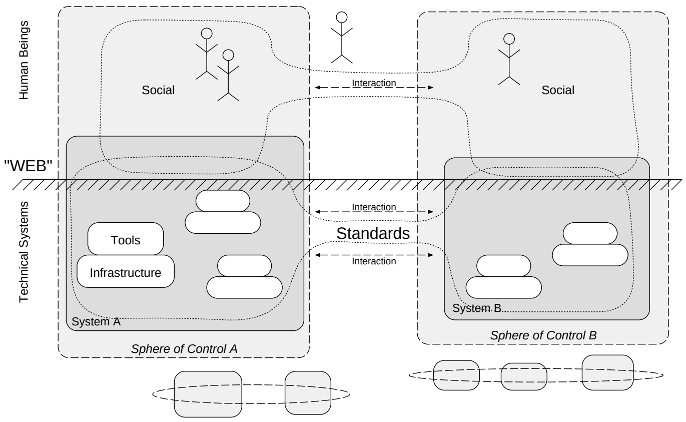

Figure 1: Collaboration Problem Space

We hope that the participants as well as the readers of the workshop's proceedings share our impression that the workshop has been successful, but that, nevertheless, the discussion has to be continued. We invite all readers to participate.