Physual Designing Network – Addressing Inter-layer Collaboration in Dispersed Teams

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Abstract

Pressure to reduce lead times requires corporations operating in global markets to use innovative approaches to address collaborative performance and concurrent enterprising challenges. Virtual enterprises consist of a wide variety of team structures engaged in a blend of planned and on-demand interactions. In many industries, such as the oil industry, the staffing on project teams is constantly changing. This paper describes a collaborative infrastructure that allows greater flexibility by supporting on-demand interaction in dispersed combination teams consisting of a collocated core team and mix of distributed regular members and occasional contributors. This infrastructure is a technology/method hybrid for value chain collaboration in extended enterprises where ad-hoc interactions occur frequently. The infrastructure is called the physual designing network and it is aimed at supporting inter-layer collaboration by lowering the collaborative entry barriers for occasional contributors, in order to facilitate knowledge contributions from subject matter experts, customers, suppliers and others.

Keywords

Collaboration, on-demand interaction, extended team, portal, team flexibility

1 Introduction

New product design using concurrent enterprising methods involves planned and on-demand interaction where different types of internal and external contributors participate. This paper describes *physual.net*, or the *physual designing network*. This is a new approach that addresses the collaborative needs of extended teams, where occasional contributors play a significant role.

Due to the strategic needs of multi-site organizations and alliances among separate enterprises, organizations increasingly depend on distributed teams [David, Lloyd, 2001]. Furthermore, multi-organization product development is identified as an increasingly important strategic option for firms developing products characterized by large scale, diverse technologies, and long duration [O'Sullivan 2003]. Although the collaborative team structures in use are growing more complex and less uniform, most research has focused on single, homogenous teams [O'Sullivan 2003]. However, dispersed teams are typically composed of various sub-teams. Within the dispersed team is a proximate sub-team located close to the client and one or more distant sub-teams located further away [David, Lloyd, 2001]. Today's infrastructure makes it easier than ever to locate and utilize external resources on a temporary or permanent basis. Virtual professional communities [Katzy, Ma, 2002] represent attractive sources of such occasional contributors, or temporary participants that contribute with their expertise.

Physual designing [Kristensen 2003] is a new concept that integrates physical arenas and virtual tools for collaboration with visual working methods through the use of large, interactive displays. This concept is developed to support dispersed collaboration in a variety of team configurations in extended concurrent enterprising networks, with emphasis on dispersed combination teams consisting of a collocated core team and a mix of distributed regular team members and occasional contributors. In particular, the concept of physual designing has been developed to support knowledge transfer, with high viscosity in knowledge transactions involving several categories of collaborative stakeholders, including occasional contributors. The term "viscosity"

refers to the richness of the knowledge transferred [Davenport, Prusak, 1998]. Physual.net acknowledges that there in many situations exists an asymmetry of resources in dispersed combination teams. This is shown in figure 1, displaying the three layers of collaborative proximity.

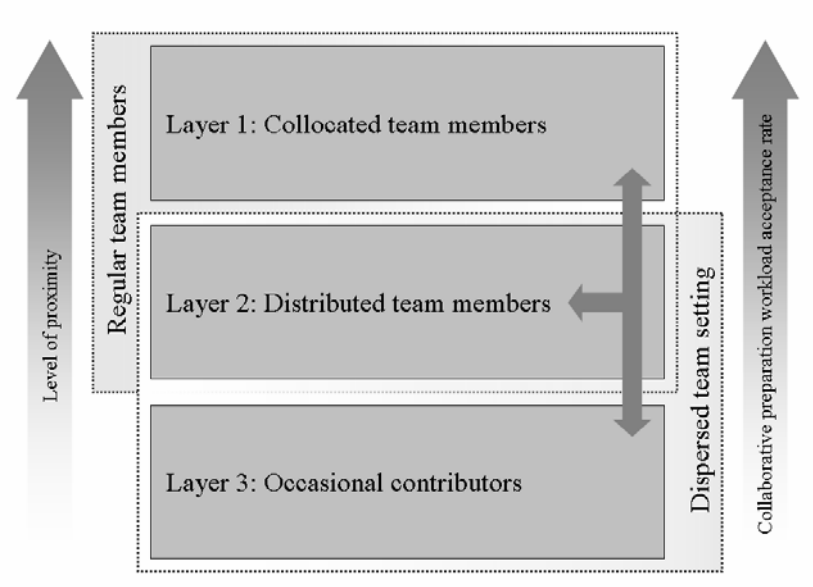

Figure 1: Layers of collaborative proximity; stakeholders and consequences

Figure 1 describes the relations between different levels of proximity in different groups of stakeholders, and how proximity is correlated with workload acceptance related to preparation of collaborative sessions. Inter-layer collaboration is emphasised, as indicated by the three-directional dark grey arrow. This inter-layer collaboration causes many problems as stakeholders involved in this type of collaboration experience greater asymmetry than when involved in intra-layer collaboration. Physual.net combines live streaming video (web cast) and other collaborative tools in a "no membership, no login" gateway that increases the feeling of presence for occasional contributors, while allowing regular team members to use their internal systems where appropriate.

2 Existing Theories and Work

The technology and channel diversification that has taken place over the last decade supports the trend toward dispersed teams. Today, there are a vast number of available communication channels, and many of these have overlapping functionality, by sharing similar features. The following categories of different collaborative technologies have gained widespread popularity over the last decade: 1) email, 2) teleconferencing, 3) video conferencing, 4) data conferencing, 5) web-based collaborative tools, 6) proprietary groupware tools, 7) electronic meeting systems [Bajwa, Lewis, Pervan, 2003].

This research uses a typology of three different layers of collaborative presence, as described above. Originally, only two layers were used; collocated core teams and regular, distributed members. Hence, no distinction was made between regular team members and occasional contributors. However, in several collaborative processes that have been observed in the years 1999 – 2004, there has been a tendency to use a "lowest common denominator" approach where the additional work of providing access to collaborative resources supporting knowledge transfer with high viscosity, has a preventive effect. This is particularly relevant when there are inherent,

geography-based differences in the access to resources. More specifically, the “lowest common denominator” approach rules out those tools and methods not available to all contributors, and as a result, often consists of email and telephone conferencing. These basic technologies do not support the interactivity and knowledge transfer viscosity offered by more advanced systems, such as eye contact and shared whiteboards and documents.

The other categories of systems (video conferencing, data conferencing, web-based collaborative tools, proprietary groupware tools and electronic meeting systems) support knowledge transfer with higher viscosity than email and telephone conferencing. These systems are designed to facilitate an even access to resources; all collaborators should have the same access and similar (often role-based) privileges. Common for all these systems is therefore that collaborators either must have access to dedicated hardware (video conferencing systems) or have access to systems that require a login procedure.

As an example, a well-established dispersed team that have invited one or two external partners in a meeting, have several options to choose from. They can either

1. Fly in the external partner for on-site access to all resources,
2. Open up their off-site systems by adding the users to a member directory and provide login information, or
3. Use substitute systems and transport work between these systems and their main systems (on- and off-site) by export/import routines.

The two first categories represent high cost, high benefit scenarios, while the latter represents a low cost, low benefit scenario, and all categories have both advantages and disadvantages. Common for all approaches is that they seek to make the collaboration as symmetric as possible, either by providing a full set of collaborative resources to all participants, or by using only those collaborative resources that are readily available to all participants.

One can argue that collaboration is most effective and efficient when all participants including occasional contributors are given full access to all collaborative systems. However, this often requires involvement from network administrators, and data security remains a problem. Furthermore, occasional contributors are often invited just moments before the collaborative session starts, which cause additional problems. For regular team members involved in intra-layer collaboration, time spent on adding users to a collaborative system is an investment because this makes future interaction more effective and efficient. However, the future pay-off does not exist or is poorly defined for inter-layer collaboration, either unscheduled or planned, especially if this interaction takes place one or just a few times. As a result, email and telephone remain at the core of including occasional contributors in ongoing collaboration, as the expected pay-off does not justify the investment required to provide full access to collaborative systems.

In order to maximise the amount of knowledge absorbed and used, and retain as much as possible of its original value, the “lowest common denominator” approach provides limited value. This finding triggered the development of physual.net, which represents a fourth option through acknowledging that the collaboration is asymmetrical, and by providing collaborative systems particularly designed to facilitate inter-layer collaboration and integrate occasional contributors. Physual.net allows asymmetry, and utilises one-way channels where this adds value. This is a way of ensuring proper access for occasional contributors while maintaining the benefits of allowing regular team members to use their internal collaborative tools and methods.

These investigations indicate that making a distinction between regular team members and occasional contributors would prove useful for the scenarios described above, and it was decided expand the framework by defining occasional contributors as a third layer.

3 System Description

Physual.net consists of a set of technologies and some suggested collaborative methods, aimed at lowering the barriers for engaging in collaboration. The system contains the main components described below.

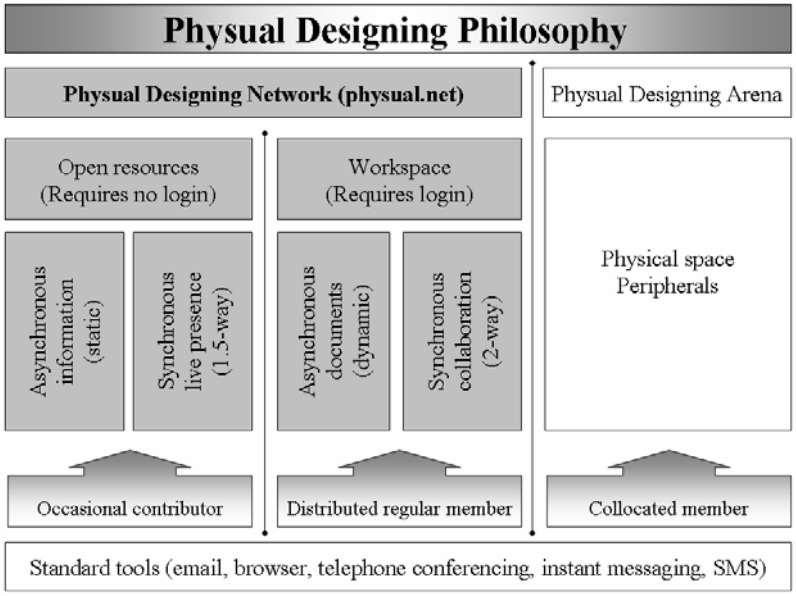

Figure 2: Physual.net spectrum of collaborative resources

The spectrum of collaborative resources has been developed to fit the asymmetry of different inter-layer collaboration scenarios, as described in figure 1.

3.1 Technologies

A number of different features make it easy to connect and collaborate in various team configurations. The main components can be divided in four groups as displayed in figure 2:

- Asynchronous information (static): Features include links and document downloads, a section covering news and events, a FAQ section, a description of the design studio collocated arena, personnel resources, and a section providing an overview of typical "best practice" collaborative scenarios and guidelines for collaboration. The guidelines section is provided to lower training requirements for using the system. No login is required for accessing asynchronous information.
- Synchronous live presence (1.5-way): Features include a streaming camera system. This system is designed to provide videoconferencing functionality with increased accessibility, by using IP cameras that are available through an ordinary web browser. The camera system combines an advanced, remotely controllable camera with pan, tilt and zoom, with a fixed overview camera. Due to the asymmetry in technologies and methods used, this communication is categorized as "1.5-way". No login is required for accessing synchronous live presence.
- Asynchronous documents (dynamic): Features include an asynchronous virtual workspace with project plans, member information, group SMS functionality and a document archive with preview functionality and version control. The preview functionality supports office documents, sketches, drawings. Login is required for access to this part of physual.net.

- Synchronous collaboration (2-way). Features include full data conferencing functionality. Login is required for access to this part of physual.net, and it may also be necessary to open ports through firewalls for data traffic.

In addition, standard tools used together with the physual designing network include email, browser, telephone conferencing, instant messaging and SMS (mobile telephone).

3.2 Methods

The physual designing philosophy consists of a set of suggested methods embedded in the technology described above. Although a detailed description of these is not within the scope of this paper, milestones and storytelling are important components in the overall physual designing philosophy. This "storyline engine" is a simple form for event reporting that is adapted to the concept of storytelling. More specifically, it is a reporting structure that assists the transformation of experiences during events and milestones into story elements. By providing a brief overview of the most important events that take place, successes or failures, the storyline transforms a series of events into a basic structure for building a story.

3.3 Stakeholders and Design for Asymmetry

Physual.net consists of physical artefacts and virtual resources. Combined, the different components of physual.net define a continuous spectrum of accessibility across different groups of stakeholders. This spectrum is displayed in figure 2. Figure 3 indicates how a typical collaborative session may appear for various stakeholders.

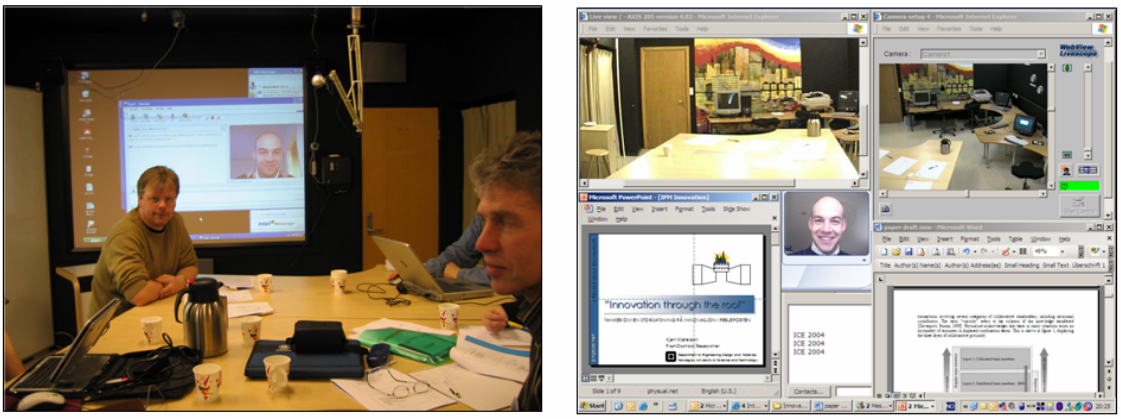

Figure 3: Design Studio view for collocated core team (left) and distributed member (right).

Please note that the picture to the right is for illustrational purposes, and in order to provide a better overview of the arena, no collocated members were present in the collocated arena at the time of the screen capture. The upper left window in the picture to the right in figure 3 corresponds to the picture to the right of figure 5, while the upper right window in the picture to the left in figure 3 corresponds to the picture in the middle of figure 5.

4 Research Approach

The three layers described in this paper are supported by different tools for inbound and outbound communication, based on the inherent asymmetry of dispersed combination teams. This is shown in figure 4, displaying how physual.net is an asymmetric tool for outbound communication in layer one and inbound communication in layers two and three.

A fully operational version of the physual designing network was launched at www.physual.net in January 2004. This version is currently being tested and revised as a non-profit academic prototype space. It has been tested thoroughly for two months, supporting full day seminars,

formal demonstrations, weekly meetings lasting 1.5 hours each, plus daily planned and ad-hoc meetings. As the physual designing network is a recent initiative, the approach has not yet been implemented in large industrial projects. However, the system has proved to be a popular system for daily planned and unplanned interaction both within the research group and in particular with external partners. Two specific application scenarios are therefore provided, to give an idea of the system's intended usage.

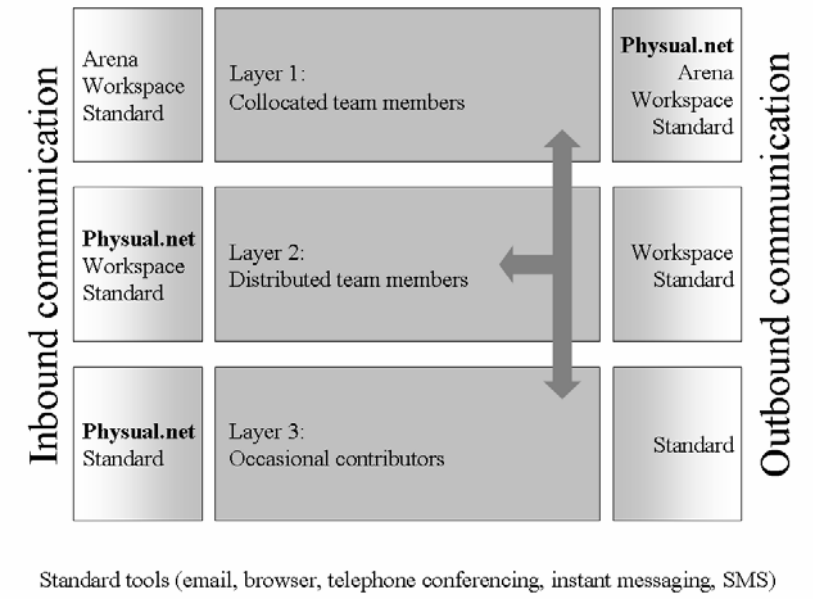

Figure 4: Layers of collaborative proximity; inbound and outbound communication

4.1 Application Scenario 1: Using Physual.net for Daily Interaction

Since Physual.net was launched, it has been used for daily interaction between Trondheim and Oslo. In this application scenario, one of the authors uses the infrastructure offered through the physual designing network for daily interaction with one or more members of the research group. Physual.net is here used for both planned and unplanned interaction. By launching the live presence camera system and running this as a small window in one corner of the screen, distributed members can see what is going on and easily connect with others. They have a full overview of what is going on in the collocated arena, and engaging in close collaboration is just a phone call away. Originally started as a pilot study to explore the features of the physual designing philosophy, physual.net has gained popularity and is used for a variety of processes such as conceptual design work, decision making, research discussions, planning and formal presentations.

4.2 Application Scenario 2: Dispersed Engineering Design

The second application scenario is a typical engineering design project. A manifestation of this scenario is an ongoing (at the time of writing) project that uses physual.net as an infrastructure for interaction with distributed members, occasional contributors and customers.

The project is the first that uses the physual designing philosophy to improve knowledge transfer viscosity and collaborative performance in dispersed teams. Figure 5 shows some of the views available through physual.net, and provides a snapshot of the project described in this application scenario, more specifically a customer interview in the initial stages of the project. The picture to the left shows the physual.net portal, more specifically the "scenarios" section providing an overview of some typical usage scenarios. The pictures in the middle and to the right show the

live presence camera system. The picture in the middle has remotely controllable pan, tilt and zoom. The picture to the right shows the static overview picture that is mounted in eye height. As shown in figure 5, dispersed members can easily monitor the studio and see if interesting activities are taking place.

Figure 5: Physual.net website, camera with pan/tilt/zoom functionality and fixed camera

The camera system and other applications can be positioned according to individual preferences. The desktop user interface with the live presence system and typical applications such as Outlook, PowerPoint and Word, is shown in figure 3, as it appears on a typical distributed member's desktop.

5 Findings

User feedback indicates that the physual designing network has a low entry barrier for inter-layer collaboration. As a result, regular, distributed team members have in many cases chosen to rely only on the functionality offered through the physual designing network. This was a surprise, as the authors expected that the physual designing network would be used as a stand alone system primarily by occasional contributors. Physual.net therefore has applications outside the original scope of the project, which was to provide a collaborative solution with low entry barriers for occasional contributors.

The physual designing network has been used for collaborative processes such as coordination, discussion, decision making, sketching, and conceptual design work. Teams have varied in size from two to seven. In the two application scenarios outlined in this paper, physual.net has become the preferred collaborative space for collaboration in extended, dispersed teams. By supporting inter-layer collaboration among collaborators with different degrees of collaborative presence, physual.net offers a streamlined approach to global collaboration for planned and on-demand interaction.

In terms of investments the physual designing network approach compared favourably with video conferencing systems for inter-layer collaboration, as it requires only modest investments, and only at the collocated arena. In terms of operating costs, IP based systems have distinct cost advantages over telephony-based systems, particularly when collaborating across national borders.

6 Conclusion

The physual designing network or physual.net is a gateway for dispersed inter-layer collaboration in various team configurations. A collaborative typology with three layers of collaborative proximity is proposed:

- Collocated, regular team members (full access to all on- and off-site resources)
- Distributed team members (full access to all off-site resources)
- Distributed, occasional contributors (access to physual.net and select collaborative tools)

Pilot studies indicate that physual.net is easy for external contributors to connect to and use as a presence-enhancing system. This approach expands the functionality of advanced, technology-rich physical arenas for collaboration, first and foremost by increasing the feeling of presence and team feeling for occasional contributors. These benefits are obtained without the additional work of including these contributors as regular team members with full access to all off-site systems. User feedback indicates that physual.net is comparable to video conferencing systems in functionality, but with higher usability and higher flexibility when engaging in inter-layer collaboration with occasional contributors.

The popularity of physual.net in the application scenarios outlined in this paper strongly indicates that the approach of creating a collaborative solution with low entry barriers can assist knowledge transfer with high viscosity in teamwork involving one or more occasional contributors.

The physual designing network concept emphasizes time, process transparency for all stakeholders, and proper distribution of collaborative benefits and costs. Physual.net supports collaboration in extended combination teams, composed by any combination of collocated and distributed contributors on a regular or occasional basis. By incorporating arenas, collaborative workspaces and other tools and methods designed to assist transitions between physical and virtual spaces, physual.net combines an infrastructure for knowledge transfer with high viscosity with low entry barriers.

The physual designing collaborative philosophy may not be equally suitable for all business sectors due to security issues. It may still be applicable for most business sectors emphasising flexible interaction and time to market in processes involving intra-layer knowledge transfer, due to the low entry barriers of physual.net.

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