Supporting Informal Communication across Local and Distributed Communities

Antonietta Grasso, Frederic Roulland, Dave Snowdon, Martin Muehlenbrock

Xerox Research Centre Europe
Grenoble, France
{grasso, roulland, snowdon, muehlenbrock }@xrce.xerox.com

Maurizio Mesenzani
Roberta Morici

Butera e Partners
Milan, Italy
{mesenzani, morici}@irso-bep.it

ABSTRACT
Several works have recently addressed usage of public large displays pushing information to trigger synchronous and asynchronous informal interactions in organizations. They are often referred too as Ambient Displays. This paper attempts to articulate what are the organizational needs and benefits, in particular, considering which aspects of the interactions inside communities of peers (the so-called community of practice) can be supported by such systems. Finally we present some considerations about which are the implications on the design of the technology, and how it can promote and encourage system usage.

Keywords
Knowledge management, communities of practice, knowledge sharing, social environment, learning organization

The relevance of informal communication and collaboration

What differentiates a learning organization, an organization able to sustainably produce value and innovation? Some light on this complex question has been brought by two complementary set of concepts, that started development at beginning of the nineties: the concept of *community of practice* [1] and the concept of *ba*[1] as an enabling environment for the community itself [12]. In their work Lave and Wenger undertook a major rethinking of the whole learning process by re-conceptualizing how it happens. In their conceptualization learning occurs not because of the consumption of some external "knowledge", coming from the external world to us, but through the support of mechanisms that are inherently social interaction among people working or living together. Learning is proposed as being supported by the participation in a community of practice, in a first stage that is legitimately peripheral and gradually increasing in engagement and complexity. So, the community of practice is the *real and virtual* place for learning and knowledge sharing: a community of practice is a *real* place because is based on real people, connections, communication, interactions, work and information flows; it can be a *virtual* place since it removes space barriers and formal constraints, since it does not require a physical location, nor a clear position on organizational charts.

This learning paradigm has been investigated in the context of work organizations also by Nonaka and Takeuchi [2], who examined several industries and the way that innovative products and concepts are developed. Subsequent to these observations they proposed a model of value creation in companies, based on a learning cycle involving both the individual and the organization. In their model the knowledge that increases organizational value is not an object stored in a database nor a personal set of competencies. The relevant knowledge is that which is shared and used in communities of people, during working processes and formal or informal social situations, such as a meeting, a training classroom or a coffee-break. These communities are the same that have been studied by Lave and Wenger: they identified that their main attributes are of being voluntarily and informally built across the organization, bound together by shared interests, shared expertise and a *passion for a joint enterprise.* What is

[1] *"Ba" is a Japanese term which roughly translates into the English word "place".*

important to note here is that these communities are on one hand recognized to be the hidden engine that keeps an organization creative and competitive, while on the other hand are a fragile structure that is based principally on the spontaneous effort of their participants.

These communities are based on forms of informal communication that can vary in form. Kraut et al. have proposed a taxonomy where the typologies of informal communications are identified in scheduled, intended, opportunistic or spontaneous exchanges. Some further user observation [9] data have highlighted that the majority of the interaction are brief, unscheduled, frequent and dependent on physical proximity; finally and importantly this study reports that as much as 80% to 90% of interpersonal interactions in the workplace are not planned meetings.

On the other side, organizations are undergoing major changes, in particular with respect to the increased need for team work and distributed collaborative work. Today's companies activities are mainly organized around task forces, process or project teams, and this is true for managerial tasks as well as for operational and clerk tasks. Recent studies in the field of planning and control disciplines say that project-based activities are increasing their effort percentage with respect to the overall workforce effort: it means that cooperation and communication among team members, among teams and across teams will be the main management issue of the next years. These emerging ways of work have a strong impact on companies' micro-organization as well as on working places layout [10]. For example Gartner Group reports a forecast where this trend is clearly visi

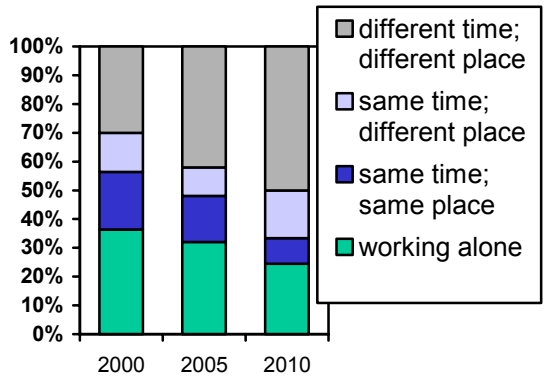

Fig. 1. The change in the way to work (source: Gartner).

However if teams and organization sites starts to be distributed and the patterns of work are changing as well with an increased mobility from the office setting (working from home or being at customer sites, for example), the question of how to support for the informal communication, which is recognized to be so important, is obtained.

In the work that is presented after we introduce some work that we have done around Ambient Displays (examples of related systems can be found in [1, 4, 6, 7, 9, 12, 14]) in support of promoting informal communication among located and not collocated members of an organization.

The system is called Community Wall and adopts the bulletin board metaphor to dynamic post relevant information (as recognized by the members of a community of practice) as long with people commentaries about it. The system is also interactive and people can add/pick information at their convenience. This system, as every system in support of community of practice, should make the interaction easy and low cost, and this is the very first step when designing systems that are meant to support virtual communities. In the rest of the position paper we first give more details about the Community Wall; then we enter in the details of how large screen displays can contribute to the support of distributed communities and how they should be designed in order to reduce the cost of participating to them.

The Community Wall

The purpose of the CommunityWall (or CWall for short), is to support information discovery in and across communities of practice [14] and create an environment that fosters social encounters (conversations) using documents and/or news and peoples' opinions on them as a trigger. The CWall provides a focus on social activity in a similar way as notice boards, which display notices concerning current community activities (ranging from formal printed notices to hand written scraps of paper). The CWall is one of the user interfaces of a recommender system [3, 14] that was originally designed for the Web and then extended to other channels in order to better respond to the easiness of use that is required by systems that are in support of community exchange in work organizations, and therefore not directly targeting the primary objectives of the work practices, which are more project or task oriented.

The CWall consists of a large screen display and associated hardware (see Figure 2), a software module that manages the display of items on the large screen and a software module for performing content selection. We are currently planning a number of extensions and these will be briefly introduced in the section about further developments.

The current CWall is composed of the following modules:

Collection

- Storage Interface – It is in charge of monitoring community exchange and events and provide the content in a way that is appropriate for presentation.

Processing

- Content Selection - The part of the CWall that decides which items have the highest priorities at a given instant. At present the priorities are re-evaluated every 10 minutes (this is user-definable).
- Backstage rules – The rules determine the relevance of a specific item at a specific time. The CWall configuration specifies what rules are used in what circumstances. Rules can be applied to different classes of items. For example, a long-term strategy document can be evaluated according to other criteria than a reminder for a meeting that is taking place today. In order to keep the system simple, rules are currently implemented as Java(tm) classes that obey a standard interface. Since the rules are written in Java they can perform arbitrary computation and access information maintained by the CWall.
- Item Pool - A cache of items (documents) that are currently "active" in the sense that they are recent or that people are actively reading them, rating them or commenting on them.

Presentation

- Display Manager - The component that is responsible for the high-level management of the display. This component takes the items provided by the content selection module and displays them appropriately according to their priority. It decides how much space to allocate to some information.
- Topics - manage all visual data for a given topic (item). It performs document transformation to map the document content to the display format of the CWall. This format separates meaningful text (e.g. removing menus and frames from web pages) from meaningful images (e.g. removing decorative images).

User interaction

- Interaction widgets - The components that handles the following interaction modes:
  - Touch the item to expand the amount of space given to the item (up to the limit of about 30 lines of text).
  - Touch the action items to trigger actions like emailing the document to oneself.

Fig. 2. The CWall in use.

The cost/benefit ratio

A characteristic of this kind of systems is to be a "shared" information space, aiming at being fresh and highly informative content collected on the base of current activities and interests of people. In none of the examples mentioned here, the system is a critical element to pursue the work, it is more an additional layer to make it smoother or faster or more creative or all of them. In this sense these systems can be considered as *common goods* likely to be happily consumed, but more difficult to be happily maintained and nursed [5]. This aspect is for example reported in the experience around the Apple Newspaper, where they report a drop in the usage after the first wave of enthusiasm or in our own experience with CWall, where we have experienced drops in the usage in correspondence of periods of time where the unit was experiencing troubles which were much more short-term and impacting the daily life. Furthermore, horizontal and informal communication processes have the value to be spontaneous and real time processes, but they risk to be fragmented, redundant or uncompleted. The emerging issue for companies is "awareness": the managerial question is "How can I be sure that the right people know company news and the right recent facts?". Paper boards and intranet home pages have failed: paper boards require a management effort largely overcoming the benefit produced and require to have only paper-based communication items; intranet home pages are not used as frequently as news changes, and are containing mainly top-down communication, so that they are substituting house-organs and corporate journals, but are not supporting anyway horizontal communication, inter-organizational relations nor awareness.

In terms of expected benefits, CWall is matching several companies' goals. Increased communication and cooperative work means increased costs of traveling, meeting, decision processes, interactions, even if it has a

strong positive impact on the value of the output, in terms of quality and common feeling. CWall are pointing on reducing interaction costs by providing a tool for contextualize videoconferencing, for supporting informal meeting sessions, and to support social situations by providing knowledge exchange opportunities even when people are not working at their desks. Videoconferencing in particular is going to cut off travel expenses by 40/50%: this is the business result planned in a user organization (BeP) of the MILK[2] project.

CWall is reducing directly the cost of awareness, providing a point to connect people to people and people to contents exploiting the peripheral awareness of people when they are not working at their PC, but move around the organizational sites, e.g. when collecting a print or entering in the morning. Furthermore, CWall does not require administrative effort: once contents are available on a shared folder, they become available with no additional efforts. This means that companies need to invest only on hardware and software configuration, while fixed costs or add-on expenses are not increasing.

In the next paragraphs we will go through a more detailed set of expected benefits.

How the Cwall can support distributed communities (increasing benefit)

Systems in support of communities of practice are typically electronic spaces that provide both a repository of the knowledge created by the community and provide additional functions that are in support of the life itself of the community, like being able to ask for support from peers or address collaboratively problems. Communication can be both synchronous and asynchronous.

The role of technology in support of communities is of being an enabler, that facilitate and maybe reinforce mechanisms and interactions already in place in the organization. In a recent survey of existing technology [14], several dimensions have been identified as relevant in support of communities of practice. In Table 1 there is a comprehensive list of aspects that have to be supported during the life of a community; for each of them technology can provide some support and the usage of Ambient Displays can complement such support, even if it cannot be the sole one. In the following table we list all of them and mark the ones where the usage of visual ambient displays can be of support.

Community need	***Function***	***Support by Ambient Displays***
Presence and visibility	Providing visibility of the community to its members	**X** The public display is a reminder of the community activity that is encountered while doing other activities in the work space
Rhythm	Supporting periodic events	
Knowledge-generating interactions	Supporting interaction	**X** Interaction can be both co-located and with remote members and is triggered by the information on the display
Efficiency of involvement	Making it easy to participate	**X** Decoration of public places used for other activities
Short-term value	Making expertise available	
Long-term value	Support for projects that are related to the practice	
Connections to the world	Relevant news from the external world	**X** Provision of news that get contextualized to a community
Personal identities	Support of personal reputation	**X** Making public what the individual contributions are
Communal identity	About providing a sense of "place"	**X** Community information is visible where both members and not members have other activities
Belonging and relationships	Support for communicatio n	**X** By triggering face to face interactions
Evolution: maturation and integration	Flexibility in integrating new functionality	
Active community building	Management of community evolution	

Table 1. The benefit dimensions in support of communities of practice

[2] MILK (IST Project 2001-33165) is the acronym of Multimedia Interaction for Learning and Knowing. MILK Partners are: Irso, Butera e Partners, Orbiteam, University of Milan Bicocca, Domus Academy, Fraunhofer Institute, PictureSafe, Xerox Research Centre, Xerox Global Services.

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What technology can do

The issue of facilitating informal and unplanned communication can be addressed in a variety of ways, including organizational policies like incentive schemes or the promotion of a knowledge sharing culture. We believe that also technology can play a role, especially in lowering the cost of using some sharing and communication technology and in the following we focus on this technological aspect.

We will focus on two aspects:

- How to choose the information by means of static profiles;
- How to affect the behavior of the screen by dynamically sensing profiling what is happening around it.

Static profile based on editorial rules

Since only about 10-15 items can fit on the display at one time CWall has implemented a mechanism for automatically selecting items from the database. Items can be classified into a number of types (sticky note, paper, meeting, conference announcement, etc) and each type can be associated with a rule which is responsible for assigning a priority to items of that type. For example, the relevance of a scientific paper might be linked to its numeric rating and the number of comments it has received, whereas a meeting announcement might rise in priority shortly before the time of the meeting and then fall to zero afterwards. We implemented a number of simple rules and the possibility to compose them hierarchically so that administrators of a display can compose composite rules using a simple text configuration format without having to understand how to program. At intervals (currently every 10 minutes) the system reapplies the rules to any active items (those that have been created, rated, commented on or interacted with in the recent past) and selects those with the highest priority for display. This means that the display changes often enough that people who pass by several times in a day should see different items. It also allows the system to give priorities to different types of item at different times of day.

The implemented library of rules includes a rule that adds a small amount of random noise and a rule that decreases the priority of items according to how much time they have already spent on the display in order to prevent a few items from monopolizing the display and to ensure that users see a variety of items if they pass by the display several times in one day.

Dynamic profile based on context sensing

However, the static rules, can account for generic mechanisms that are stable in a community, like recognizing what are the most discussed and appreciated news or information. On the other side, these systems should also be able to attract and maintain attention in a way appropriate to the surrounding activities, as well being able to process and display more transient information, like where people currently are. We are currently in the process of extending the behavior of the Cwall in order to be more reactive to information and also include more information (e.g. people availability) on the display. These features will also support the extension of the system to include unplanned videoconferencing across sites, which is highly demanded by our user organizations in the context of the MILK project. In the following we resume our current understanding of the extension possibilities in terms of dynamic context sensing of activities around the Cwall area.

As regard the presentation on the display, it can automatically be improved by taking into account prior interactions of the user with the screen as well as further information from the environment in which the display resides. This information is potentially useful in adapting the presentation on the display to the situation in front of it. For instance, it can be very helpful for the system to be able to differentiate between situations in which people are just passing by and situations in which people are standing in front of the screen and looking at the items presented. For passers-by, the information on the screen could be presented in an eye-catching manner and change frequently, whereas the information shown to an interested reader could be more detailed and stable. Hence by using contextual information such as the activities of people in front of the screen, the selection of information to be presented as well as the presentation itself can be targeted to specific situations.

A variety of sensors exist that may be used to capture the situation in the display's environment. Widely available are infrared sensors, cameras for image analysis, microphones for sound analysis, active badges [15], pressure floor mats, etc. In addition, also mobile devices such as personal digital assistants that communicate via the display's infrared port can be regarded as some kind of sensor. The situation parameters that these sensors possibly deliver can be location-oriented or person-oriented data. Location-oriented data is comprised of information on the number of people in the display environment, which can be further subdivided into the number of people in the room where the display is located (if at all), in the screen area, and in finer-grained screen sub-areas such as left or right of the display. Person-oriented data relates to individuals and the orientation of their faces towards the board, their movement, and particularly their identity. The type of data the different sensors could deliver is outlined in Table 2.

		Infrared sensors	*Image analy-sis*	*Sound/ Speech analysis*	*Active badges*	*Pres-sure mats*	*PDAs*
Location -oriented	Persons (#) in room	X					
	Persons (#) in screen area	X	X	X	X		X
	Persons (#) in sub-areas (near/far, left/right)	X	X			X	
Person-oriented	Face-orientation		X				
	Movement	X	X			X	
	Identity		X		X		X

Table 2. Sensor types and situation data they can provide.

The quality of the captured data can be improved by combining data from a number of sensors. For example, infrared sensors that are arranged in a grid-like manner could deliver more detailed information on the number of people and their distances to the screen. In addition, the combination with data from an image analysis of a camera signal could help to disambiguate the situation description. Clearly, there are limitations to the information that sensors can deliver, especially in regards of capturing the identity of people in the screen area. On the other hand, some simplifications are reasonable from a purpose-driven perspective. For the adaptation of the screen presentation as taken as an example above, it is sufficient to differentiate between situations with only one person, two persons or any higher number of people (see also Table 2).

Situations that could be interesting to detect and be used for context-aware presentations range from simple descriptions of the number and movement of the people in front of the screen at a given time to more rich descriptions in terms of their activities and interests. The former usually relate to additional sensors that are installed in the display's environment. The latter, however, cannot directly be observed but have to be derived by combing data from a number of sensors and other information sources and by processing and abstracting these data.

The GroupCast project has done some investigation on the display capability to react to the precise identities of the people in front of the screen. In [12] it is reported the sequence of investigations that the project went through. In a first stage the system, comprising an active badge infrastructure, had been designed in such a way to contain a global profile where each user would specify the content of interests. In such way the detected group of users in front of it is used to compute the intersection among their interests in the global profile and then show something that each of them could talk about in order to sustain the conversation. However, they quickly noticed that such a profile should be very large and therefore a bit unpractical and very rarely filled in, also because its usage was specific to the usage in GroupCast. Subsequent to this a new version of the system was using the personal profiles and display content that was of interest to at least one of the persons in front.

Another way to use contextual information captured by sensors is by supporting ambient telepresence. Ambient telepresence connects people at remote locations by the provision of sensor-based awareness. A demonstrator application has been developed that tracks background activity in the workplace by monitoring manipulation of computer keyboards and coffee cups [1]. At a connected remote site sounds are generated to represent the remote activity, to give it a virtual presence. The ways contextual information could be reasonably used for several visual ambient displays in remote settings still have to be explored. A possible direction is the provision of information on the presence and immediate availability of persons at a remote site to facilitate opportunities for interaction.

Further developments

Ambient Displays are an emerging topic of research, but are already attracting companies investments. This is due to several factors. On one side this is due to technology advance in areas like devices, displays and sensors and on the other from the intuition that they can be used to surround people with information that gracefully stays in the periphery to move in the center when needed. In this paper we have focused on a specific subset of Ambient Displays that rely on usage of public visual information in support of informal communication in work organizations. We have first argued that a specific workgroup typology, the *community of practice*, can particularly benefit from this kind of systems. However, because the community

participation is usually not the primary focus of work for the community members, for these systems it is of paramount relevance to be designed in such a way to minimize the costs associated to their usage and to be attractive. We have then first presented an existing implementation and then identified a set of design dimensions particularly aimed at reducing the costs, showing first attempts to address them in existing implementations. We believe that this promising area of work would greatly benefits from more attempts along the lines of better structuring both the organizational mechanisms that are addressed and the issues that are related to their successful adoption.

The work that has been presented here is going to be further refined in the MILK European project. In this context we are developing a "social environment" based on Cwall solutions [19]: this will respond to business goals expressed by the user organisations that are partner in the project. As an example, Butera e Partners will expect to use Cwall to permit continuous awareness of relevant information and the possibility to open videoconference sessions between its locations (Rome and Milan), to present public communications such as "mails to all" or news published on the intranet (but currently very rarely read and discussed). More added value will be provided by the opportunity to see on the Cwall who are the colleagues working in the two locations in order to help informal meetings and conversation even among people that are working in different buildings. Furthermore, the Cwall will show the contents of the corporate servers, giving access to the shared folders and to the intranet home page. All these features are expected to have dramatic effects on the overall quality of working relations and on cost reduction goals: travel and communication costs will be cut significantly by extending the working space in the real/virtual way provided by Cwall.

So, in the next years we will have two different ways to develop Cwall solutions within companies. On the one hand, companies are willing to increase their "communication features", in order to reduce costs and to enhance quality of interactions among people: this will be done for example through videoconference functionalities, through chat and mail sessions available on large screens, alerting and awareness systems, presenting company news and facts in a public and social space.

This will be made possible by Cwall solutions because they are integrated with knowledge management systems in order to manage and display information and contents according to community and users profiles, and presenting the right information in the right way, highlighting qualifying data and capturing users attention by use of intelligent sensors, that can adapt at best content and presentation styles. This is the big driver and reason why companies that have been contacted within the scope of the MILK project are interested in Cwall technologies: *users attention*. We are in an age of information overload: intranets and Internet, email systems, sms, paper mailings are bringing to users plenty of un-useful information in different formats. The fact is that they are mostly individually based systems with poor ways to differentiate communications, so, important information get lost within the amount of material received or browsed. Cwall solutions are not intended to be used by a single user (not as the email inbox, or the palm, or the mobile phone), but on the contrary they are going to be used by groups and communities together on line or off line; they intend to support the highlighting of relevant information for individuals, teams and communities of practices and are providing users with advanced communication functionalities.

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