

A Reflection on E-Collaboration Infrastructure for Research Communities

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INTRODUCTION

E-collaboration amongst researchers requires not only the people working together but all the layers of a collaborative system working together as well, starting at the point where people interface with the system. Although this article concentrates more on the technical infrastructure required for e-collaboration, the influence of the social and people issues on the conceptual design of the interface and the functionalities of the collaborative system will also be discussed. Often, the interface/interaction between the 'soft' and the 'hard' issues generates some interesting and dynamic effects between the layers of the infrastructure (Dourish, 1999).

As a starting point, this article presents a framework to illustrate the dependencies of the different layers of the infrastructures for a collaborative system. Against this background, a case study undertaken since the early 1990s on an e-collaborative environment will be discussed. The system, named the Virtual Knowledge Park (VKP), developed from a number of research projects and grew into a commercial platform. The developmental journey for the infrastructure used in the case study will be reviewed alongside the lessons learned.

The article concludes with an extrapolation of the infrastructure that is required for future research collaborations.

BACKGROUND

The common reference point to the beginning of collaborative systems can be dated back to 1984 when the term *computer-supported cooperative work* (CSCW) was coined by Irene Grief and Paul Cashman (Grudin, 1994). With the coining of terms such as *e-commerce*,

e-government and *e-communities*, e-collaboration has become the latest label for CSCW.

The starting point of e-collaboration, however, can be traced back even before 1984 when e-mail, teleconferencing systems and office automation were the emerging technologies (Hiltz, 1984; Wainwright & Francis, 1984). The label groupware (a term first used by Peter and Trudy Johnson-Lenz) took over around 1990 to refer to the technologies for CSCW and included a wide range of applications (Ellis, Gibbs, & Rein, 1991). Advances in networking provided a driving force for the development of these collaborative systems. In particular, the system architecture could then evolve from being monolithic and centralised to becoming client-server and decentralised. Collaborative systems are becoming more pervasive (Chung & Dewan, 2004) in both the work and the social spaces of users.

Another driving force came from the World Wide Web (WWW), which became available to the commercial world in the 1990s. This in turn introduced various collaborative tools to a wider user base. These tools originally had been restricted to academic or large commercial organisations. This opening up of access fuelled the pace of development and the deployment of tools such as e-mail software on clients, discussion forum, instant messaging, and file sharing. These tools have become defacto standard functionalities in any collaborative systems today.

The availability of bandwidth has also made multimodal interaction a common experience in today's collaborative environments. Users do not just interact in text, but also in audio, graphical, and video modes. This has offered researchers new ways of working together, and richer media for the exchange of information, knowledge and ideas.

The next section charts the evolution of collaborative systems against the evolution of the other different layers of the underlying infrastructure. This can provide some insights into the shape of things to come.

EVOLUTION OF THE INFRASTRUCTURE FOR E-COLLABORATION

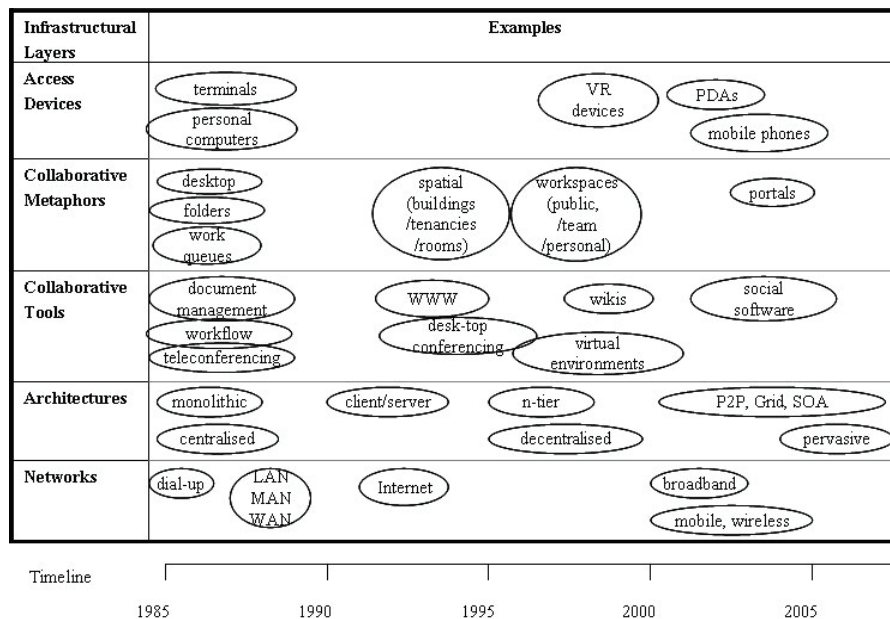
The technical infrastructure for a collaborative system consists of a number of layers interworking with each other. A framework is devised to analyse the evolution of each of these layers (namely access devices, collaboration metaphors, tools, architectures, and networks) and how each layer might impact on the development of the others over time (see Table 1). The timeline in the table only charts the period when the selected collaborative tools had a commercial presence.

In the mid-1980s, the human-computer interface changed from being text-based to becoming graphics-based, with icons representing items that were familiar on or near a desk at work. A “collaborative” environment typically consisted of e-mail and office tools. More complex systems such as Lotus Notes also started to emerge (IBM, 2005) for improving document management and internal communications. Workflow management systems (Kobine, 1986) were used to route forms from one person to another and to maximise the degree of automation. A mainframe mentality was still dominant hence architectures were typically centralised. Local area networks (LAN) began to make an impact as a common network infrastructure. Only the large international organisations had wide area

data networks (WAN) in place. These kinds of systems are still evolving—mostly being incorporated into an enterprise wide system and ported to the Internet with a browser front-end for access.

In the early 1990s, desktop computers gained more processing power. This encouraged the increasing use of graphics and video. There were experiments with various different metaphors on the computer screen, such as a graphical representation of buildings, rooms, workspaces, and so on. The workspace metaphor seems to have had the most long lasting appeal as it can still be found in today’s products such as BSCW, eRoom, Groove, and VKP (see later sections). The World Wide Web started to make an impact but mainly for sharing hypertext documents. The range of applications increased when the client-server architecture was extended to the n-tier architecture (Lubich, 1995). After the mid-1990s, it was possible to run more complicated applications with database technologies and wrappers over the Internet. W3C standards became more mature. Virtual environments such as online communities mushroomed with a range of tools at their disposal (Benford, Brown, Reynard, & Greenhalgh, 1996; Pfister, Schuckmann, Beck-Wilson, & Wessner, 1998). There were attempts at mixing 3-D graphics into these online communities and the provision of desktop videoconferencing facilities, but the bandwidth was not high enough to meet user expectations regarding performance. There were

Table 1. Adoption of commonly known technologies in the infrastructures for e-collaboration



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