

# PARADIGM SHIFT IN INTER-ORGANISATIONAL COLLABORATION

## *A Framework for Web based Dynamic eCollaboration*

Ioakim (Makis) Marmaridis and Athula Ginige

*AeIMS Research Group, University of Western Sydney, Sydney, Australia*

**Keywords:** Dynamic eCollaboration, World Wide Web, Collaboration Paradigm Shift, Bitlet, Workflow Engine, P2P.

**Abstract:** The proliferation of the World Wide Web (web) offers new ways for organisations to do business and collaborate with others to gain competitive advantage. Dynamic eCollaboration has the characteristics to keep up with the fast changing business landscape. It requires however a framework for collaboration that can also keep up with rapid change. In this paper we present the Dynamic eCollaboration model that brings the concepts of P2P collaboration to organisations. It fills this gap and offers a new avenue for organisations of all sizes to embrace collaboration and benefit from it. We also present our technology framework built to support Dynamic eCollaboration. The framework is component-based and extensible with an architecture that can scale. It incorporates a flexible security subsystem, a lightweight workflow engine optimised for web applications and a novel method for bundling and sharing web based information called Bitlet.

## 1 INTRODUCTION

Business collaboration as a means to gaining competitive advantage is well established (Lee, 2004) and the area of collaboration in general receives a lot of attention from researchers. From collaboration between individuals (Cap, 2003; David et al., 2005; Scott et al., 1997) to group collaboration (Mandviwalla and Olfman, 1994; Dus, 2004; Sun, 2003; Thomas, 1997; Mark et al., 1996) and collaboration for enterprises making their resources accessible to select partners and business associates (Cha, 2004; Sybase, ; Aissi and Chan, 2003; Donnan, 2002) a lot of systems have been developed to support it. Some have started off as research platforms (Arb, 2002; Egi, 2004) subsequently either turning commercial or remaining free and open source and others, particularly targeting enterprise collaboration, come from very well known vendors. Oracle (:20, 2003), Novell (Novell, ), IBM and Microsoft are just few of the large vendors that have delved into providing solutions for collaboration of some form. While the quality and feature set of these solutions vary greatly, some of these offer a host of features and abilities to the organisations who can put them in place. Although the col-

laboration space is full with solutions for most types of collaboration, the authors have observed the lack of viable solutions for electronic collaboration between small and medium organisations (SMEs) although they could benefit greatly from adopting those. The reason is that all existing business collaboration solutions follow the same paradigm that does not work well in the SME space. The authors advocate a paradigm shift in the way inter-organisational collaboration happens. We strongly believe that Dynamic eCollaboration (Marmaridis et al., 2004) that models this new paradigm can offer tangible benefits to SMEs and other larger organisations. We also firmly believe that Dynamic eCollaboration can be practically facilitated via a web-based framework. This paper presents the new paradigm the authors advocate for inter-organisational collaboration and the framework that can support it.

## 2 MOTIVATION FOR THIS WORK

We have been researching electronic collaboration for over four years aiming to understand why SMEs are not adopting electronic collaboration using the web. In the wider context look we look for the optimum way to perform and facilitate web based inter-organisational collaboration. We view the web as a mature platform for cheap, secure communication and therefore an enabler for collaboration (Marmaridis et al., 2004). During this time we have surveyed the landscape of collaboration tools and methods from inter personal to enterprise-level collaboration. There are many tools from many vendors, some representing excellent use of technology with impressive feature sets however they still all fail to appeal to the SMEs, who hold the middle ground in the collaboration landscape. We therefore started looking beyond technology solutions and saw that a paradigm shift is necessary in the way collaboration takes place. There must be more choice offered to individuals within an organisation when it comes to collaborating, and at the same time organisations must know they have control over the information they share with others. A policy-driven, completely top down approach leads to micro-management and does not work in the long-run, on the other hand a bottom-up approach that allows individuals to freely share information without maintaining control does not work either. Through interacting with SMEs that wish to collaborate we derived the desirable characteristics of such an engagement and we also took into account the particular circumstances of SMEs that include lack of IT expertise and lack of large infrastructure investment for collaboration. A detailed analysis of these characteristics in the context of SMEs can be found in some of our previous work (Marmaridis and Unhelkar, 2005). To fulfil these requirements we therefore derived an evolved model of electronic collaboration called Dynamic eCollaboration (Marmaridis et al., 2004). We define Dynamic eCollaboration as flexible, electronic collaboration based on short to medium term projects where business partners have ephemeral relationships and are able to opt-in and out from each project at any time. Wishing to see Dynamic eCollaboration be adopted in the real world, we went on to design the key infrastructure components necessary to support the nearly ad-hoc, dynamic nature of collaboration. This paper presents this framework in detail because we believe that Dynamic eCollaboration and its associated paradigm shift has many benefits to offer to organisations of all sizes not only SMEs.

## 3 CONTEMPORARY COLLABORATION PARADIGMS

There are three major types of collaboration one can find via academic literature or by observation amongst people and organisations. Collaboration between individuals on one to one basis, group based collaboration and enterprise-level collaboration. These three types differ significantly in the following aspects:

**Trust** Different trust levels are necessary to establish and maintain each type of collaboration. Individuals require little trust up front, groups more and enterprises the most.

**Risk** Inter-personal collaboration has the least which explains why instant messaging networks are in such high use. Group collaboration involves more risk as it requires more commitment and resources to setup and get going in the first place. Enterprise-level collaboration has the most amount of perceived risk as decision-making may be critical depending on the type of collaboration.

**Amount of information exposure** Similarly to the previous factors, individuals in an IRC channel can disguise their own identity rather effectively, in groups it is harder to do so and also more information is exchanged. Finally at the enterprise level company secrets may be disclosed by accident or otherwise and information may be very damaging if it reaches competitors by any chance.

**Amount of control** Individuals are content with being able to interrupt the communication as soon as they like. They can stop responding to emails or instant messages, they can remove a web page with information that they have put online. Groups have little control over what is shared, by whom and for what purpose, this is sometimes advantageous and other times it is not. Organisations feel the need to exercise a lot of control because of the critical nature of some collaborations and the sensitivity of the information exchanged.

**Collaboration Direction** Bottom-up for individuals and groups, with people taking initiative to contribute or not, comment and provide feedback or otherwise. Top-down, policy driven, with steps to police access, and log activities, these are the characteristics of enterprise-level collaboration.

In inter-personal and group collaboration everyone participating is able to contribute equally and to a large extent they are expected to. In enterprise-collaboration, participants are typically in two groups,

internal staff and external partners or associates. Staff are the people who put up information and contribute the bulk of it with external partners mostly consuming information and contributing either simple documents or comments and ideas. This is justified since giving partners access to internal systems via an extranet can be a very complex undertaking in order to safeguard security giving rise to issues of identity management, single sign-on, policy based access control to different internal applications and still involving large risk in letting outsiders access your own internal systems. In inter-personal and group collaboration on the other hand, there is usually no need for cross-authentication or identity management, as this is a bottom-up approach.

### 3.1 Problems with Contemporary Collaboration Paradigms

For business collaboration a bottom-up approach is too informal, it does not offer any guarantees that information leaks can be detected and contained in a timely manner. On the other hand, the top-down approach may be workable to an extent for large enterprises when they deal with a few well established business partners and where an army of IT experts is available to configure and maintain “enterprise grade” collaboration systems. Everyone else in between including SMEs is not really catered for by these two ways of performing electronic collaboration. SMEs for instance require some level of inter-organisational trust to be in place before they engage in collaboration, on the other hand they cannot afford the top-down rigour enterprises try to exercise due to cost and time constraints. On the other hand, they need the flexibility of letting their staff take decisions about what is shared in the context of each collaboration and also allow their partners an equal footing to also share just as freely their own resources. Finally, they can benefit greatly by allowing access to web applications they are running internally and at the same time they cannot afford the price and complexity of systems that can give them federated identity management and single sign-on like enterprises use and battle with.

## 4 THE NEW AND EMERGING PARADIGM OF DYNAMIC ECOLLABORATION

The requirements SMEs and other organisations have from eCollaboration are not catered for by the current paradigm enterprises use to share some of their re-

sources with others. When you think about it it is almost as if SMEs are like individuals in the amount of flexibility they require. Yet again they want to maintain some high level of control over the entire process that can in turn mitigate the risk of critical information being exposed.

This is where the paradigm shift is necessary to allow the flexibility and ad-hoc nature of inter personal collaboration in a business setting. Dynamic eCollaboration can give rise to this paradigm by working at three levels. Firstly, it sets up a context for the overall collaboration between two or more organisations requiring them to reach an in-principal agreement to collaborate. Secondly, it maps each actual engagement into a project that is used to keep related activities together and also simplify the interactions for staff that is involved in each project. Finally, in the context of a project it allows freedom to the members of the project team to contribute and share resources and interact with one another. The degree of freedom is configurable on a per-project basis and although high by default it can be turned down as needed. Also all the information shared is trackable and sharing can be revoked at any time at the project or the whole organisation level.

Figure 1 below shows graphically how Dynamic eCollaboration would be represented on the same landscape as the other types, inter-personal, group and enterprise-level collaboration.

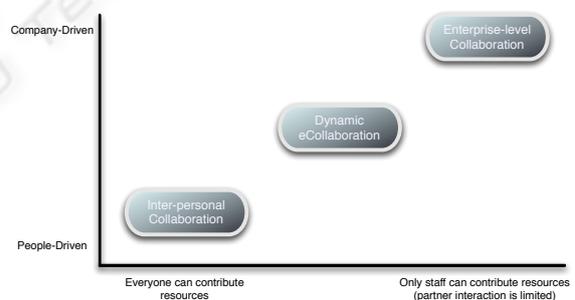


Figure 1: Dynamic eCollaboration in the Landscape.

Dynamic eCollaboration fits in-between the other two approaches and allows everyone in a project to contribute resources while at the same time activities are user driven (in the context of overall approval by the business owners of the respective organisations). Dynamic eCollaboration is able to do this by introducing a number of key concepts as follows: An upfront inter-organisational agreement mapping the initial trust between each partner and providing an umbrella for each collaborative project. Mapping of collaborative activities into projects in order to reduce complexity and provide better management overall.

The introduction of Virtual Teams that work on each project and whose members come from all collaborating partners and have the ability to contribute and use available resources. A novel mechanism for sharing web accessible resources including applications in a controlled and flexible way. Finally, a method for sharing business processes between partners via mapping them onto executable workflow definitions.

## 5 THE DYNAMIC ECOLLABORATION CONCEPTUAL MODEL

At its core, Dynamic eCollaboration involves staff members from one or more organisations working together and sharing information and business processes. The information sharing may take place via a given application or through a series of applications and document exchanges. Likewise, the business process sharing may follow a prescribed format, it may be semi-structure or completely ad-hoc. Figure 2 visualises Dynamic eCollaboration in action. We will use this figure to explain the different parts of the conceptual model in detail below.

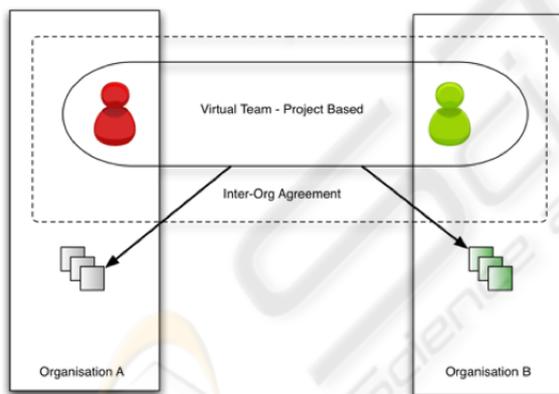


Figure 2: Conceptual Model of Dynamic eCollaboration - Users in a Virtual Team make resources from their organisations accessible.

### 5.1 Inter Organisational Trust in Dynamic Ecollaboration

The model takes into account the importance of Trust in Dynamic eCollaboration and therefore has a built-in requirement for up front inter-organisational Trust between the parties that will be collaborating. Before any work can take place, a once-off trust must be established and it has to be kept current and in

place in order for other work to happen between staff in the partner organisations. Establishing this Trust requires that there is in-principle agreement between key stockholders in each partner organisation that they are willing to join forces and work with one another.

This step also has two more desirable effects that assist in Trust building and lower the perceived risks of organisations taking part in collaboration. The two effects are as follows:

#### Unanimous acceptance of new entrants required.

Where there is an established collaboration underway, a new partner can only be introduced if all others agree to establish this high level of inter-organisational Trust with them. Effectively this prohibits one partner from bringing in another organisation they may feel favourably towards without the consent of all other participants and therefore increase the risk of information exposure for those other partners.

#### All sharing depends on Inter-organisational Trust.

Trust plays a large part in the amount of collaboration an organisation is willing to enter to and the degree of information sharing they are willing to allow. Therefore, having ultimate control over what information is shared across all collaborative engagements allows organisations to be less sceptical about embarking on Dynamic eCollaboration. In more traditional forms of collaboration there may be some upfront requirements for establishing who the collaborative partners are however there is no easy way to stop each and every interaction with a particular business partner easily.

When it comes to entering into Dynamic eCollaboration the conceptual model offers a set of five steps as shown in figure 3 that organisation can follow.

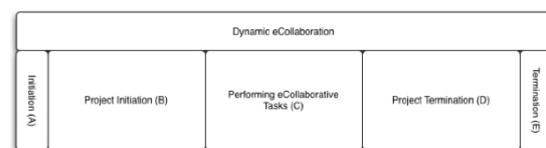


Figure 3: Dynamic eCollaboration requires inter-organisational trust to be in place before any joint work can take place.

If for instance there are two organisations that wish to collaborate and they have never had a chance to work with one another before, in step A their stakeholders would come together and have an in-principle agreement about collaborating. This agreement may have some legal binding effect but more importantly

it must be codified in the respective platforms for collaboration that each organisation has access to and is going to be using in order to participate in Dynamic eCollaboration. This offers blanket protection for both organisations as a risk mitigation measure. It is revokable by either one and should that happen, as in step *E* in figure 3 any current collaborative activities will come to an immediate stop, including any data shared.

Once the inter-organisational Trust is in place, the two organisations can start working on joint projects that are established, managed and terminated on their own as long as the umbrella Trust is in place. At each step in the lifecycle of each project the following activities take place:

**Project Initiation (shown as stage *B* in figure 3)**

During the project initiation, one of the collaborating parties creates a new project with a description and makes it available to select other parties. All then can accept to be part of the project or not and further they can designate which of their staff members will be part of the Virtual Team associated with this particular project.

**Performing actual tasks (stage *C* in figure 3)** As the Virtual Team has been assembled for this project, its members are now able to start sharing resources they have access to with others in the Virtual Team. These resources could be in the form of applications or data - more on resource sharing follows later in this chapter. During the course of the collaborative project additional collaboration support tools may be required and used including wikis, threaded discussion forums, instant messaging and voice chat software. The Project and its associated Virtual Team exist for as long as the high level inter-organisational agreement to collaborate is in place and should that be revoked all projects and information sharing is then stopped.

**Project Termination (stage *D* in figure 3)** The project will be terminated once completed or by mutual agreement to do so earlier. The termination of this particular project does not have any flow-on effects onto other projects that may be currently in progress between those same or different organisations.

Overall, knowing that there is the ability to safely pull out of a project or the entire collaboration at any time is available, in my experience can act as a catalyst for organisations interested in collaborating. Such knowledge leads to a lower trust threshold to be required for getting into collaborative work with other

organisations, therefore encouraging participation.

**5.2 Projects in Dynamic Ecollaboration**

The conceptual model of Dynamic eCollaboration defines projects as the unit of management for collaborative activities. Each time an organisation decides to start on a new piece of collaborative work with others a new project is created to accommodate this.

Therefore projects act as containers of related information for each engagement and contain references to individual users, information about roles these users may have, ad-hoc groups that they may be part of in the context of this project and always contain the Virtual Team which is a special type of group with all the individuals assigned to the projects as its members. Finally, a project can contain other pieces of arbitrary data such as pointers to resources, access control directives and workflow definitions and instances that map to business processes. Figure 4 shows the constituents of a typical Dynamic eCollaboration project.

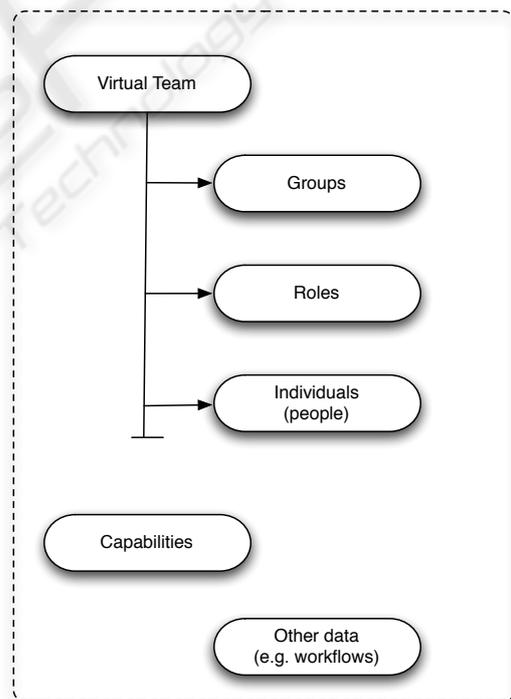


Figure 4: In Dynamic eCollaboration each project acts as a container for the Virtual Team and associated data.

### 5.2.1 The Relationship between Projects and Applications

Many other collaborative systems such as Groove (Jr. et al., 2002) and productivity applications already implement the concept of using projects to segregate information. Unlike other systems however, projects under Dynamic eCollaboration are not subordinate to applications. On the contrary the conceptual model defines projects as entities that may incorporate one or more different applications (or parts of applications) at the same time as resources. This single characteristic of the conceptual model of Dynamic eCollaboration offers large amounts of flexibility in real life implementations of Dynamic eCollaboration. For instance a project may be established that requires people to share existing documents, discuss particular issues using a threaded discussion forum and co-author new documents via a wiki. The conceptual model allows them to do all that by defining a single project where each participant has a single identity that is linked to the project. From then on, no additional overheads are necessary in order to manage access to the different applications or parts of those applications. And finally when the project comes to an end and the Virtual Team is dissolved there are no left-overs that have to be managed in the different applications individually. This behaviour of the model enhances maintainability of each project and reduces the time and effort required to manage it by reducing the amount of relationships that must be established and tracked.

Additionally, because projects can transcend applications and they can incorporate any number of resources and users from one or more organisations at the same time, they allow overlay business processes to be set-up fast. All users within a project are addressable without any concerns of their origin.

### 5.3 Virtual Teams in Dynamic Ecollaboration

The concept of a Virtual Team in Dynamic eCollaboration abstracts away the true location of members and provides a single, unified, consistent view of the people who are actually participating in each collaborative project. Also the Virtual Team is a key construct to providing access control for the different resources within each project and can simplify the expression of access control directives. If for instance a new project requires that all of its members have access to a given wiki page instead of granting access rights to each individual the same can be achieved by granting rights to the Virtual Team since by definition

it contains every person associated with the project.

Figure 5 shows a view of how people within a project may be organised for the purposes of access control and collaboration in general.

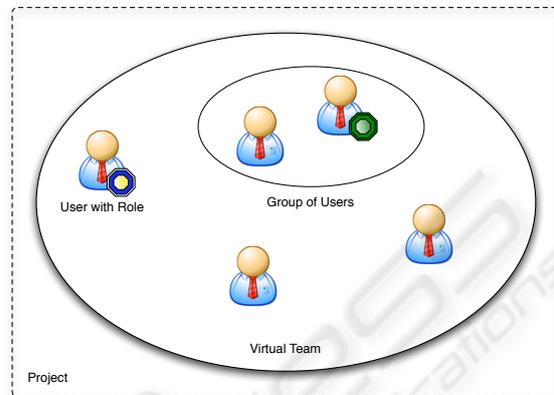


Figure 5: A Typical Virtual Team in a Dynamic eCollaboration Project.

By definition, each person that belongs into a project must also be a member of the Virtual Team, however they need not necessarily have any other roles or group memberships. Having a role does not exclude people from also being part of groups within the Virtual Team. Any one person within a Virtual Team may be member in one or more groups at the same time and they may have one or more roles also at the same time. In addition, a role may be given to only one person at a time. There is no limit to the number of users a group may contain. Role and group names must be unique within the context of a given project but need not be unique across projects. By design and to limit unnecessary complexity, no two people in the same project may have the same role. If this is desired, a group can be created instead. No groups within groups are allowed, as it would have raised the overall complexity of the model both conceptually and at the implementation level.

Another key characteristic of Dynamic eCollaboration is the speed of change in configuring projects, teams and access control within those. It is necessary that resources can be added in projects and that they can be managed with minimum overheads. To facilitate speed and lower overheads, business users must be able to configure how collaborative activities take place. The access control system in the conceptual model for Dynamic eCollaboration takes this into account and provides for fast, simpler sharing by incorporating one more important rule. Unless specified otherwise, anyone within a project is able to contribute resources provided that:

1. They themselves have access to this resource they wish to contribute already.
2. They can only grant access rights for this resource up and including their own level of access for it.

These simple rules along with the ability to segment access control by project and tie access control directives to individual users, roles, groups or the Virtual Team as a whole provide flexibility, granularity and simplicity in managing access control in collaborative projects.

### 5.4 Sharing of Information and Resources

Information sharing between users is the cornerstone of collaboration. In Dynamic eCollaboration resources can be of many types including documents, single web pages, web applications or parts thereof. Each resource is captured as a Bitlet which is a self standing bundle of information that can be easily shared with others in a project. Bitlets can be static or interactive and allow in the latter case for instance the recipient to fill in and post back any HTML forms that they may contain. Details about Bitlets, their design and technical implementation can be found in our previously published work (Marmaridis and Ginige, 2006).

### 5.5 Sharing of Business Processes

Collaboration involves the joint work of a number of users via information sharing that can be structured and fully pre-specified, semi structured or completely unstructured. Figure 6 shows the spectrum of interactions that can take place within a collaboration project.

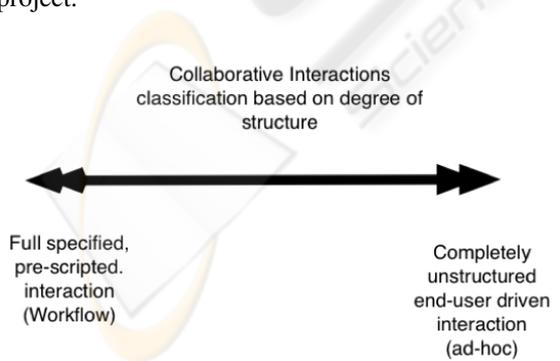


Figure 6: Collaborative interactions classification based on degree of structure.

In our experience actual collaborative projects involve a mixture of interactions that is somewhere in

between the two extremes. In the context of Dynamic eCollaboration, it is not practical to try and pre-specify each and every interaction and then rely on a workflow engine to enact the necessary sequence of events. On the other hand, fully ad-hoc collaboration may be useful at an inter-personal level however it is not always well suited for business collaboration. This is mainly because ad-hoc interactions are not typically tracked and controlled. In a business setting having the ability to revoke previously taken actions or recall shared resources for amendment or just to pull them out of circulation is a desirable property.

Unlike inter-personal collaboration, in business collaboration it is often necessary to enact business processes that transcend organisational boundaries. To facilitate this, the Dynamic eCollaboration model makes provision for a workflow engine for executing the different business processes. Unfortunately due to lack of space we cannot describe the design principles behind this in any detail. However business processes mapped to workflows operate in the context of each project and have direct ability to setting and changing access control capabilities for team members of the project. This architecture allows the design, enactment and development of a variety of business processes as needed in an evolutionary manner that supports the flexible and nearly ad-hoc nature of Dynamic eCollaboration. Along with the other components of the framework supporting Dynamic eCollaboration we have also fully implemented the workflow engine and hoping to publish its details in an upcoming conference.

## 6 CONCLUSIONS AND FUTURE WORK

In this paper we have presented Dynamic eCollaboration, an evolved form of electronic collaboration aimed at organisations of all sizes. It combines a number of key concepts around project based collaboration driven by virtual teams of people coming from different organisations to form a common working group for a particular purpose. Backed by a novel approach to sharing web based information in a controlled and reusable manner and a lightweight mechanism for sharing business processes, Dynamic eCollaboration represents a paradigm shift in the way business collaboration can be performed. It allows participants from all partner organisations to equally contribute resources for the use of the project team, not just open up existing systems and resources for use by select few in an “extranet”. It empowers individu-

als with taking the initiative to share information and resources and work collaborative while allowing each organisation to contain any information leaks quickly and effectively.

We see great opportunity for improvement in the area of resource sharing to include the ability to aggregate and share again the aggregated resources. Also we are focusing our efforts in providing better support to business users for creating new workflows for their projects easily via Ajax enabled web GUIs. Nevertheless we have implemented the technology necessary to support Dynamic eCollaboration in practice and have integrated it with our CBEADS framework (Ginige, 2002). We are currently putting the technology into practical use through our work with a group of four SME organisations that wish to collaborate with one another.

The new paradigm for business collaboration that Dynamic eCollaboration embraces will not only lead to the uptake of collaboration by SMEs, we strongly believe it will also have lasting effects in the way larger enterprises collaborate with their partners and associates.

## REFERENCES

- (2002). *MoCha: a middleware based on mobile channels*. TY - CONF.
- (2003). Oracle collaboration suite. Technical report. <http://otn.oracle.com/products/cs/index.html>.
- (2003). *Towards a framework for collaborative peer groups*. TY - CONF.
- (2003). *Yet another framework for supporting mobile and collaborative work*. TY - CONF.
- (2004). *DACS: distance aware collaboration system for face-to-face meetings*. TY - CONF.
- (2004). *Pervasive enablement of business processes*. TY - CONF.
- (2004). *Web services for groupware in distributed and mobile collaboration*. TY - CONF.
- Aissi, S. and Chan, A. (2003). Collaboration-protocol profile and agreement specification version 2.0. Technical report. [http://www.ebxml.org/specs/index.htm#technical\\_reports](http://www.ebxml.org/specs/index.htm#technical_reports).
- David, R., Hiroko, W., Kristie, K., and Rogerio de, P. (2005). *What ideal end users teach us about collaborative software*. Number 260-263. ACM Press, Sanibel Island, Florida, USA. 1099248 <http://doi.acm.org/10.1145/1099203.1099248>.
- Donnan, D. (2002). Ceo/presidents' forum - action plan for trading partner e-collaboration. Technical report. <http://www.gmabrand.com/publications/docs/ceoforum.pdf>.
- Ginige, A. (2002). *Handbook of Software Engineering and Knowledge Engineering*, volume 2, chapter New Paradigm for Developing Evolutionary Software to Support E-Business, pages 711–725. World Scientific.
- Jr., R. J. B., Agrawal, R., Gruhl, D., and Somani, A. (2002). Youserv: a web-hosting and content sharing tool for the masses. In *WWW '02: Proceedings of the 11th international conference on World Wide Web*, pages 345–354, New York, NY, USA. ACM Press.
- Lee, M., editor (2004). *Collaborating to Win - Creating an Effective Virtual Organisation*, Taipei, Taiwan. 26-27 March 2004.
- Mandviwalla, M. and Olfman, L. (1994). What do groups need? a proposed set of generic groupware requirements. *ACM Trans. Comput.-Hum. Interact.*, 1(3):245–268.
- Mark, R. C., Jay, M. T., and Jay, G. (1996). Made-fast: collaborative engineering over the internet. *Commun. ACM*, 39:78–87. 234474 0001-0782 <http://doi.acm.org/10.1145/234215.234474> ACM Press.
- Marmaridis, I. and Ginige, A. (2006). Sharing information on the web using bitlets. *Proceedings of the 6th international conference on Web engineering*, pages 185–192.
- Marmaridis, I., Ginige, J., and Ginige, A. (2004). Web based architecture for dynamic ecollaborative work. *International Conference on Software Engineering and Knowledge Engineering*.
- Marmaridis, I. and Unhelkar, B. (2005). Challenges in mobile transformations: A requirements modeling perspective for small and medium enterprises. *Proceedings of the International Conference on Mobile Business (ICMB'05)-Volume 00*, pages 16–22.
- Novell. A superior foundation for secure identity a superior foundation for secure identity management solutions.
- Scott, R., Sherif, J., and Kathy, R. (1997). *Web-based collaborative library research*. Number 152-160. ACM Press, Philadelphia, Pennsylvania, United States. 263808 <http://doi.acm.org/10.1145/263690.263808>.
- Sybase. emarketlink - enabling b2b collaboration. <http://www.eshop.sybase.com/>.
- Thomas, R. K. (1997). Team-based access control (tmac): a primitive for applying role-based access controls in collaborative environments. In *RBAC '97: Proceedings of the second ACM workshop on Role-based access control*, pages 13–19, New York, NY, USA. ACM Press.