ICDT Platform: An Overview

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1. ICDT Platform: Key Features

The ICDT Platform is a web-based virtual environment aimed at supporting distributed groups and communities. The platform is the result of research and development efforts conducted at INSEAD's Centre for Advanced Learning Technologies since 1994 in the domain of groupware design and collaborative, distributed learning. Different versions of the ICDT Platform have been employed and are actively used to support a number of applications, including:

Virtual Learning Communities and **Knowledge Exchange** applications

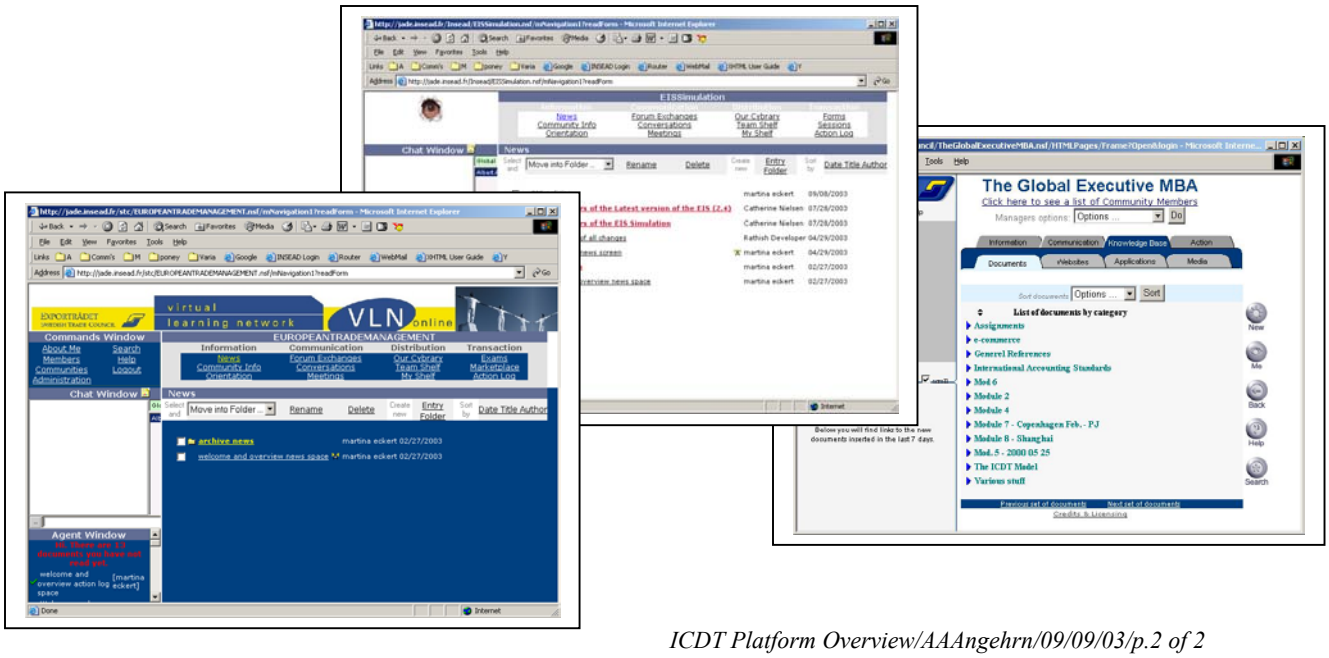
The ICDT Platform has been applied to support courses and workshops in business schools (e.g. INSEAD executive programs), full online programs such as Copenhagen Business Schools Global Executive MBA, as well as to support Learning Networks such as the Swedish Trade Council SME Virtual Learning and Training Network consisting of several hundreds distributed trade managers.

Project and **Document Management** applications

The ICDT Platform has been applied to support distributed project teams involved in R&D projects (e.g. IST projects EdComNet, eCamp, Leonardo project TRAM).

Service and **Product Development** and **Distribution** applications

The ICDT Platform is used since four years to support a community of several hundreds worldwide users focusing on the development and distribution of multimedia simulations (EIS Simulation community).



In terms of functionality, the ICDT Platform integrates features aimed at providing efficient information, communication, distribution and transaction channels used by the community of users (operating both as "suppliers' and 'consumers' of knowledge) to:

(1) increase the visibility of the **users** (individuals, groups, as well as software agents), the '**interaction spaces'** they can use and create dynamically, as well as the '**knowledge assets'** (content, services, activities) included in, accessed through and exchanged within the platform,

(2) improve and stimulate communication, knowledge exchange and cooperation potential among users

(3) support the efficient and effective publication, exchange and delivery of digital content and services of different types

(4) provide an environment for formal, workflow-related transactions among users

From a user perspective, key functionalities of the ICDT Platform include:

- Social awareness and translucence through the constantly visible **Community Chatroom** providing the possibility to see anytime who is currently logged into the platform, as well as to meet and interact with other users informally

- Access to flexibly tailorable **User Profiles** and **Group Profiles** providing transparency on individuals and groups within the community, which can in turn be introduced dynamically

- In-built **News** Space increasing communication of relevant community events

- Possibility to easily introduce and modify **user-defined interaction spaces** and **knowledge assets** of different types (from simple textual contributions, to multimedia material, structured presentations, HTML files, software, forms and questionnaires, etc. – see section 3 for more details on the different types of supported knowledge assets)

- Possibility to flexibly **reorganize** where and how knowledge assets are located within the platform

- Flexibility to **integrate** or attach any type of **digital material** related to knowledge assets, including any type of multimedia files and software (such as simulation sessions)

- Possibility to address every space and knowledge asset with a **unique URL**

- Inclusion of **rating** mechanism embedded in every knowledge asset

- Inclusion of **email forwarding** mechanisms embedded in every knowledge asset

- Possibility to define **dynamic links** among knowledge assets reflecting personalized navigation paths through the platform spaces and content

- Possibility to define the **visibility** (who is able to see what) and **editability** (who can co-author what) of individual knowledge assets or groups of knowledge assets

- Possibility to dynamically create/initiate and contribute to threaded **forum discussions** as well as icon-enhanced **linear conversations** with built-in transcript and summary capabilities

- Possibility to dynamically schedule meetings by creating and joining real time **chatrooms**, including **whiteboards** as well as **audio** and **video conferencing** options

- Easy **structuring**, **distribution**, **up-** and **downloading** of any type of digital material (e.g. courses, learning modules, simulations)

- Integrated **software agents** providing personalized services (such as reminders of unread, recent or relevant additions to the knowledge base or user community)

- Possibility to link specific **forms**, **questionnaires** and **workflow-like features** to the processing of knowledge assets (e.g. useful to administer exams)

- Possibility to access transparently the **activity logs** of users (who did what, where and when)

- Possibility to select among **different views** to best visualize the knowledge assets included in every interaction space within the platform

- Possibility to flexibly **tailor** a number of **user interface** components (logo areas, etc.)

- In-built **search functionality** operating in the whole platform or on specific subsets of knowledge assets (e.g. search of User Profiles by **specific characteristics** such as 'competencies')

- **Platform administration functions** supporting the dynamic creation and tailoring of new community spaces, the definition of roles (users, managers and administrators) with different access rights, and other administrative features

- Accessibility **anytime anyplace** on the **web** (except for realtime communication and collaboration features based on the Sametime platform – see section 4 - requiring a one-time plug-in download launched automatically – with users' consent)

2. Underlying Conceptual Model

The ICDT Platform is based on a conceptual framework develop to diagnose the efficiency and effectiveness of groupware-based, cooperative workspaces. Starting from the assumption that organizations can be seen as networks of cooperating agents (individuals, teams, task forces, organizational and inter-organizational units such as departments or Learning Networks [2], etc.), the framework views groupware platforms as efficient Information, Communication, Distribution and Transaction channels used by agents to: (1) increase their visibility within (inter-)organizational networks, (2) improve communication and cooperation potential, (3) support efficient exchange and distribution of internal content, knowledge and digital services, and (4) provide a platform for formal, workflow-related transactions among agents

2.1 ICDT: A user-centered Framework

A number of frameworks aimed at understanding the impact of CSCW and groupware platforms and guiding their design and implementation in organizational and inter-organizational contexts have been proposed over the last years [3, 5, 6, 8-11, 14]. Such research frameworks emphasize either the "process", or functional dimension of these electronic communication and cooperation platforms, or the characteristics of the group addressed and the technology employed. The framework illustrated in this section, based on [0], adopts a “user-“ or “agent-centered” perspective in that it views groupware platforms principally as a means for extending the interaction capabilities of organizational agents (individuals and groups) along 4 distinct dimensions.

The basic assumption underlying the framework is that companies can be seen as networks of organizational agents cooperating (or competing) in an analogous way as economic agents cooperate (and compete) in the global economy. Hence, "macro" frameworks developed to study the impact of global networks such as the Internet on the global economy (and more specifically, on economic agents such as companies and industries) can be adapted and used to provide insights into the impact of groupware platforms on organizations (and more specifically, on organizational agents such as individuals, teams and inter-organizational units), leading to the development of "micro" frameworks such as the one illustrated below.

The majority of "macro" frameworks developed to study the impact of global networks (and the Internet in particular) on companies' strategies view such networks as an "electronic" extension of the traditional market space [12, 13], i.e. of the locus, with its associated interaction modes, in which economic agents engage in business activities by exchanging information, communicating, distributing different types of products and services, and initiating formal business transactions. For instance, the ICDT Model (see e.g. [1]) induces a segmentation of the space of business opportunities created by the Internet into the four "virtual spaces" displayed in Figure 1:

- Virtual **Information** Space (VIS)
- Virtual **Communication** Space (VCS)
- Virtual **Transaction** Space (VDS)
- Virtual **Distribution** Space (VTS)

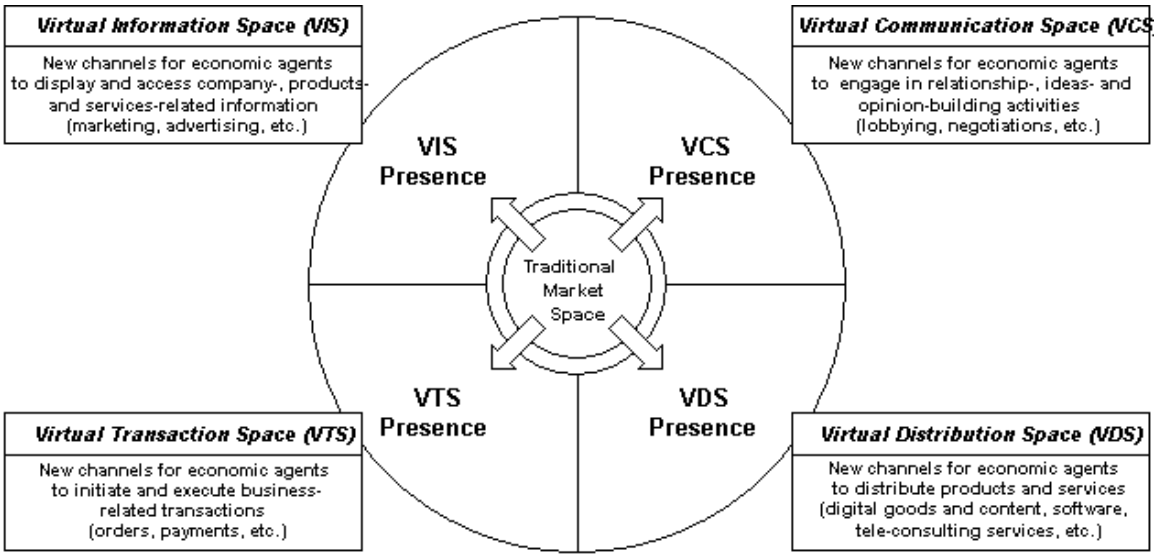


Figure 1: The extension of the traditional market space induced by the Internet

According to the ICDT Model, establishing presence in the new Virtual Information Space *(VIS Presence)* created by the Internet reveals the intention of an economic agent (e.g. a company, a professional, an association or a governmental agency) to exploit the Internet as a richer channel for exchanging information about itself and about its activities with other economic agents, thus extending its market visibility. *VDS Presence* reveals strategies aimed at exploiting the Internet as an efficient channel for distributing globally different types of on-line services and digitized products. *VTS Presence* reflects strategies leveraging the Internet as a cost-efficient channel for business-to-business or business-to-customer transactions such as invoicing and payments. Finally, *VCS Presence* reveals the intention of leveraging the Internet as a channel for developing, monitoring and influencing business-related communications as well as formal or informal exchanges between economic agents operating on the Internet through the creation of virtual communities [4] accessed by potential and existing customers, partners, customer associations, or even competitors.

2.2 Learning-oriented Groupware platforms and Virtual Interaction Spaces

In analogy to the “macro” discussed in the last section, a "micro" framework can be used to characterize groupware platforms as an "electronic" extension of the traditional organizational interaction space, i.e. the locus in which agents engage in activities by exchanging information, communicating, distributing different types of "internal" products and services, and initiating and engaging in formal transactions. This applies to platforms designed to enhance learning and knowledge exchange too. Hence, adopting a terminology similar to the one used in the ICDT Model, the framework induces a segmentation of the new interaction space created by groupware platforms into the four "internal virtual spaces": An **Internal Virtual Information Space** (I-VIS), an **Internal Virtual Communication Space** (I-VCS), an **Internal Virtual Distribution Space** (I-VDS), and an **Internal Virtual Transaction Space** (I-VTS).

The framework can be hence used to describe in a structured way the space of opportunities available to organizational agents to enhance their organizational efficiency and effectiveness through learning-oriented groupware platforms. The I-VIS provides channels for the agents to increase their visibility within the company or to access information about other organizational agents and knowledge assets available within the learning community. It can consist of simple directories ("Who does what? Who has which competencies", etc.) or take the form of a sophisticated virtual image of the company including information about all its agents, resources and processes. The I-VCS provides communication channels for "learning groups" operating within or across companies aiming at different forms of synchronous or asynchronous knowledge and social exchanges. It can take the form of simple electronic messaging systems or sophisticated communication and collaboration environments replacing or extending traditional organizational spaces such as workshop and meeting rooms. Finally, the I-VDS and I-VTS provide cost-efficient and rapid distribution, delivery and transaction channels used to distribute learning-related digital knowledge assets (e.g. courses, learning objects, learning-related material, etc.) or coordinate internal transactions (e.g. questionnaires, exams, as well as registrations and other structured exchanges among agents, e.g. between learners and tutors or administrators).

3. Underlying Architecture: Interactions Spaces and Knowledge Assets

3.1 Community and User-defined Interaction Spaces

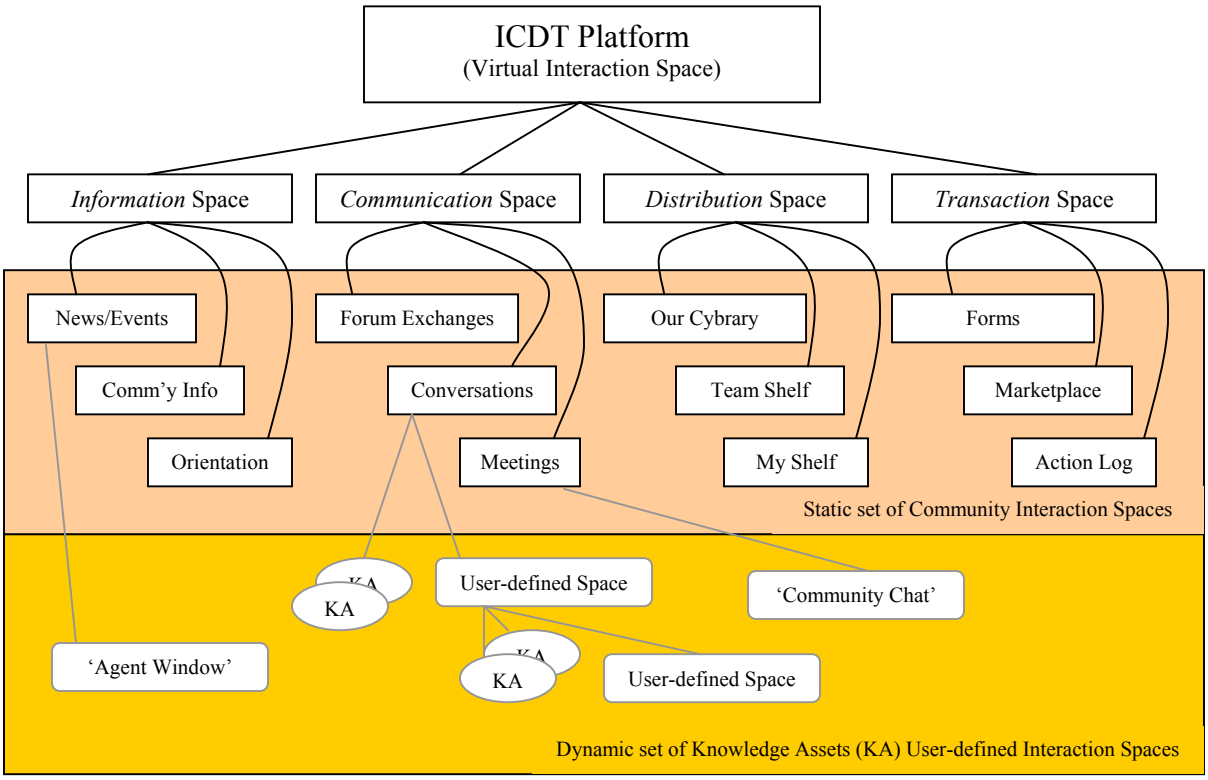
According to the conceptual framework outlined in the previous section, the ICDT Platform is designed to provide a structured set of interaction spaces which serves to:

(1) organize systematically all the knowledge assets included in the platform, and

(2) provide a basic architecture of the virtual environment in which users can orient themselves.

Therefore, every interaction space within the ICDT Platform is first of all either an Information, or a Communication, or a Distribution, or a Transaction Space. This structure is present in every implementation. Each one of these 4 main spaces is further subdivided in 3 **Community Interaction Spaces** (for a total of 12). These 12 Spaces, which the community can jointly define as a function of its specific needs and specific interaction types, provide a set of shared spaces in which knowledge assets as well as further **User-defined** (sub)spaces can be dynamically created reflecting the needs of individuals, groups or the whole user community.

The current implementation of the ICDT platform provides a set of default names for the 12 Community Interaction Spaces, which can be easily adapted to the needs of the specific users. The resulting hierarchical structure of the interaction spaces is illustrated in the figure below.



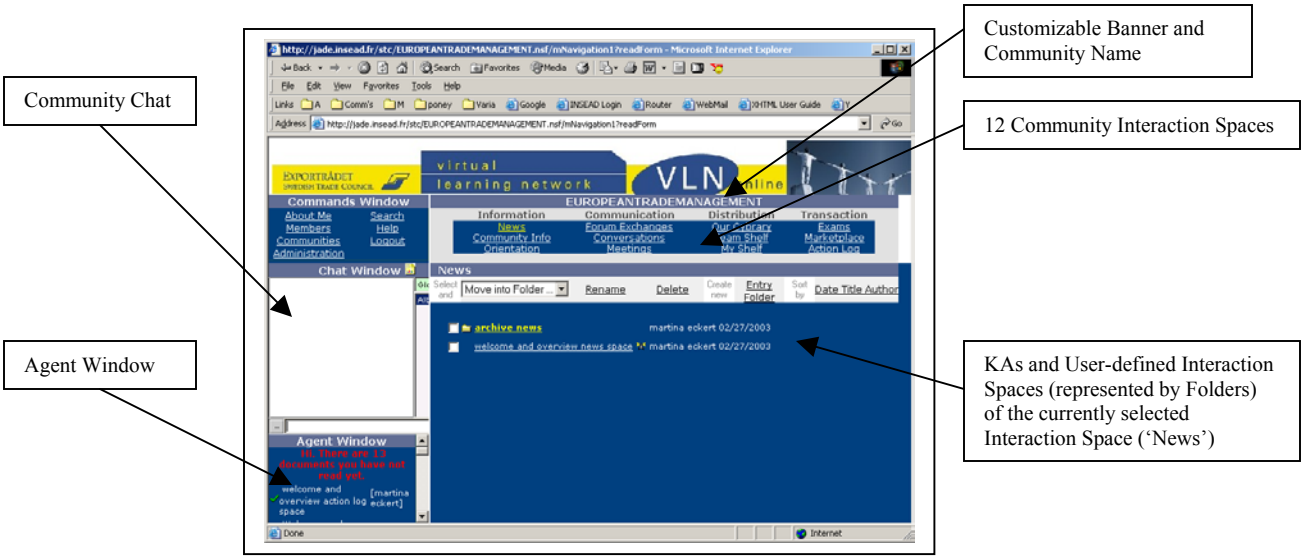
Note that the while the Community Interaction Spaces are always visible and accessible by every user, User-defined Interaction Spaces can be defined by the users to be visible and accessible exclusively to a subset of users (e.g. a group). The same flexibility applies to every Knowledge Asset positioned in any of the static set of 12 (re-namable) Community Interaction Spaces and to the dynamic set of User-defined Interaction Spaces.

In the current V3 implementation of the ICDT Platform, the 12 Community Interaction Spaces are accessible through buttons positioned on the top of the screen. In addition, two Interaction Spaces are visualized on the left hand side screen to emphasize social translucence and the services provided interaction by personal agents:

(1) the 'Community Chat', a subspace of the 'Meetings' space within the Communication Space, supports user-to-user informal interaction and identification of who is online, in order to increase exchange and collaboration opportunities as well as social translucence [7].

(2) The 'Agent Window', a subspace of the 'News/Events' space within the Information Space, supports the delivery of personalized messages by an in-built software agent.

This is illustrated by the example shown in the Figure below.



3.2 Dynamic Knowledge Assets Taxonomy and Structure

'Knowledge Asset' (KA) is the term used in the ICDT Platform for every piece of content located and shared in the platform. All KAs have a set of basic characteristics and include fields such as:

- KA type *(single value)*
- Title *(single value)*
- URL address *(single value)*
- Author(s) *(single value, user or group)*
- Creation Date *(single value)*
- Last modification date *(single value)*
- Location - Space (S) and its unique path *(single value)*
- Visibility (default: everybody, other possible values: User or group/group) *(single value)*
- Editability (default: Author, other possible values: everybody or group/group) *(single value)*
- Visits (users and dates) *(multiple values)*
- Rating (calculated on a scale from 1 to 5) *(single value)*
- Linked KA *(single value)*
- Attachments (*multiple values, 10 max*)
- Content (*HTML text*)
- Mail forward (default: nobody, other possible values: user of group or everybody) (*single value*)

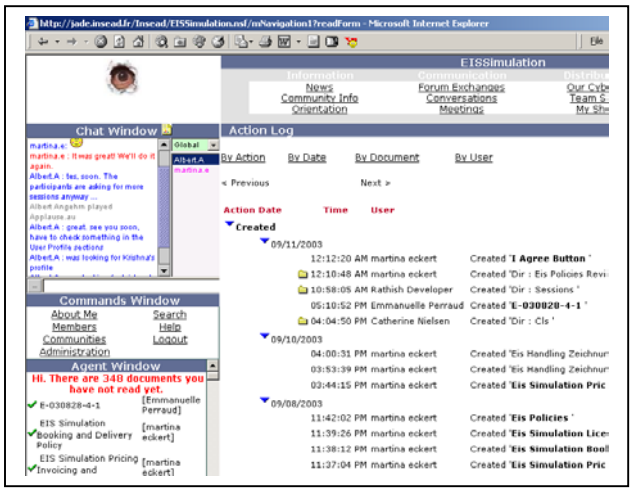
This set of basic attributes of each KA can be extended with additional fields or features into **Structured KAs** to serve specific purposes such as to support forum discussions, to launch a private chatroom associated with the KA, a simulation session, etc. Structured

KAs reflect the specific needs of the community users. The list below provides an overview of the Types of Structured KAs currently supported within the ICDT Platform.

- News Item
- User Profile
- Group Profile
- Orientation Document
- Forum Discussion
- Conversation
- Chatroom
- AV (audiovisual) Meeting
- Software
- Simple Document
- Simple Questionnaire
- Exam
- Booking Form
- Simulation Session
- Action Log Document

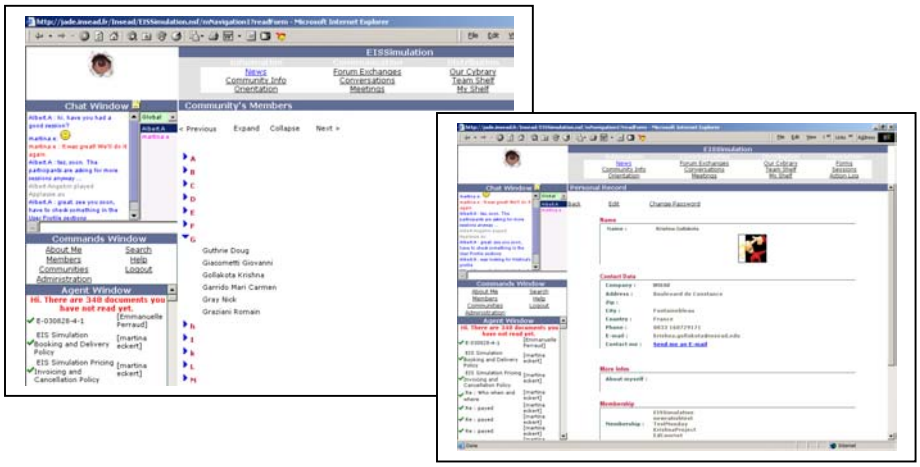
Each Structured document has special fields or features beyond the ones of a basic KA. For instance, a 'Chatroom' KA has fields allowing the specification of a given time and a list of attendees for the chat meeting, as well as buttons allowing to activate and enter a chatroom. On the other hand, a 'Simple Questionnaire' KA integrates the specific feature that all responses (Answers) will be visible exclusively to the Author of the KA, guaranteeing the privacy of respondents. The possibility to associate specific fields and dynamics to Structured KAs is practically unlimited, allowing to include on a when needed basis KAs representing for instance Learning Objects with different structures, or extend the existing KA Types such as by extending the 'User Profile' KA type with field characterizing Users along dimensions relevant to the specific application domain of the ICDT Platform.

Each KA type available within the ICDT platform can be created, edited, deleted, moved, rated, commented, responded to, viewed within a given space, etc. All these actions are in turn recorded in the Action Log Space, a view of which is displayed below:



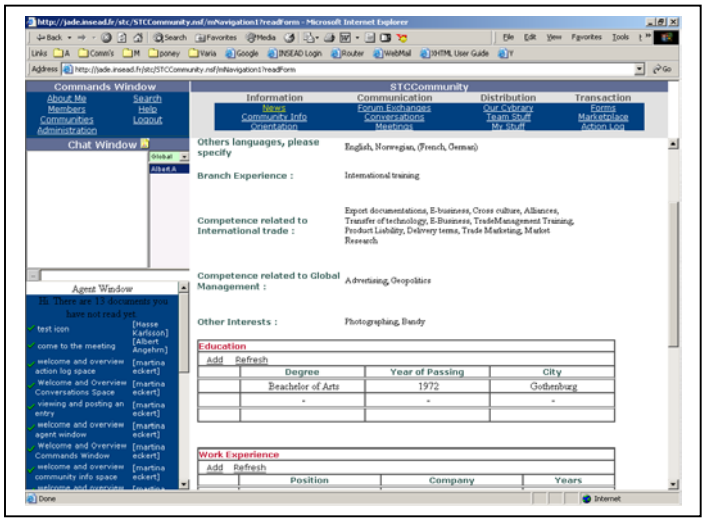
3.3 Users and Agents

In the ICDT Platform, users have direct access to a members' list including one KA (of the type User Profile) for each user (and group), as illustrated below.



Users management features can be accessed through the Administration menu. These features include the possibility to assign roles (default: user) which can range from user, to manager, to administrator.

In certain communities, the structure of the User Profile KA has been extended with specific fields such as the ones below aimed at capturing specific users characteristics, and the corresponding user search functionality.



Finally, Software Agents providing personalized messages to users (individually - appearing in the personal 'Agents Window', or addressing all users through the 'Community Chat') can be integrated in the ICDT Platform. Agents have access to the full Action Log and can hence derive their interventions from monitoring dynamically users actions.

4. Implementation Details, Openness and Tailorability

From an implementation perspective, the ICDT Platform has been developed using as a middleware the two IBM middleware packages Notes/Domino and Sametime. This choice has guaranteed over the years a high flexibility in extending the platform to fit specific needs by either using the open implementation frameworks built into this middleware of flexibly connecting (or import/export data or services) for instance through Java code (special functionalities), XML (connection to a Flash interface) or ODBC (data export and import to a personalized UI developed in the programming language Metacard). The following sections discuss the middleware underlying the implementation of the ICDT Platform (4.1) and the openness/tailorability of the platform in terms of structure, agents, user interface and data exchange (4.2).

4.1 On the Domino and Sametime Middleware

Lotus **Domino** is IBM's collaborative application server. Domino is a highly scalable, reliable and secure platform not only for enterprise messaging, but also for workflow and business process applications. Applications can be accessed with client applications ranging from Lotus Notes, full-featured, rich collaboration client, to standard web browsers and small devices such as PDAs and Wireless Access Protocol (WAP) -capable devices. As an integrated collaborative environment, Lotus Notes combines enterprise-class messaging and calendaring & scheduling capabilities with a robust platform for collaborative applications. You can take advantage of the advanced functionality, reliable performance and dependable security - and help reduce your total cost of ownership in the process.

Domino integrated application services provide a platform for rapid delivery of collaborative applications. Built-in connection services provide live access to leading relational databases, transaction systems and ERP applications. Also it is possible to use third party web development tools along with the Domino integrated development environment. A promising solution is the exploitation of **Proposion N2N** native data connector. N2N enables .NET developers to access Notes Domino data and services from any .NET application and enables Notes/Domino developers to take immediate advantage of Microsoft .NET tools such as VB.NET, C#, ASP.NET, Mobile Internet Toolkit, and .NET Web Services (http://www.cisoft.com/site/proposion.nsf/pages/N2N), which can be used for the integration of Domino with the .NET framework).

Furthermore, Notes/Domino offers web applications capabilities such as real-time collaboration with instant messaging and application sharing, threaded discussions, document libraries, virtual meeting rooms, and ad-hoc workflow management. It can be extended with some other Lotus/IBM products in order to improve its collaborative capabilities (such as Sametime, QuickPlace, LearningSpace, Domino.Doc, Workflow, Mobile Services, etc.). It offers one of the industry's most comprehensive support for internet messaging standards, with internet addressing (SMTP, MIME, SSL, POP3, LDAP, HTTP, HTML, etc).

Main features of Domino include:

- Advanced reliability and security
- Centralised management of user configurations for individuals, groups or even an entire organization
- Centralized directory resources
- Easy administration by supporting multiple organizations and languages on one Domino server
- Improved clustering, formula engine, fulltext searching, network compression and replication
- Interoperability with other application servers, such as Domino R5 server, WebSphere server, Sametime 3 server and QuickPlace 3 server

The **quality and scalability** of this middleware underlying the ICDT Platform is guaranteed by several successful cases like the current website of IBM Australia[1] developed using the same technological options (although without the integration of SameTime API elements). The use of middlewares such as Domino/SameTime and Flash also increases reusability and integrability of components developed, leveraging the extensive user basis (in business, government, education, research as well as other contexts) and developers community.

Research wise, as extensive number of projects addressing eLearning, community and 'social' computing are using the same technological platform for conducting research on features particularly relevant to the use of ICT in social contexts. INSEAD's research agreement with IBM and its Research Labs in Haifa, Israel, and in the US, will guarantee the link to a **state-of-the-art research and developments** stream in the area of **social computing** which is relevant to eLearning-related projects and to which the project can definitely contribute.

For components and services supporting realtime communication and collaboration, the ICDT Platform is based on SameTime, IBM's solution for web conferencing. SameTime consists of two modules:

- The Lotus Sametime Enterprise Meeting server, which includes Web Conferencing (an e-meeting service) and Instant Messaging (a service to send and receive text messages). This server aims to deploy security-rich, Web-based collaboration quickly, easily and cost-effectively, without a big up-front investment in resources and skills.

[1] http://www.ibm.com/au/

- The SameTime client, in order to access the server and use functionality such as streaming audio and video, shared documents, presentations, application sharing, and instant messaging

Other characteristics of the Sametime middleware include:

- Authentication and access control
- Security and privacy
- Supports of the Session Initiation Protocol (SIP) for instant messaging
- Scalability. Application-sharing sessions allow hundreds of people to view the same application or presentation whiteboard.
- Proxy support and firewalls
- Server management

4.2 Tailorability/Openness of the ICDT Platform

The middleware on which the ICDT Platform is implemented guarantee a high level of openness and inter-operability with different standards, and hence the possibility to tailor a number of components to the specific needs of an other environments built 'on top' of it or attempting to integrate it with other software modules.

From a structural perspective, the 12 ICDT **Interaction Spaces** can be tailored/renamed without any implementation efforts to the specific users needs. Further subspaces can be introduced dynamically as **User-defined Spaces** (see section 3). The creation of new **Views** associated to an interaction space can be also performed with minimal implementation effort.

Furthermore, the design and integration of new types of **Knowledge Assets** with specific fields and features (to model for instance Learning Objects or other structured types of knowledge assets) can be greatly facilitated by the Domino Designer development environment.

The same applies to the implementation of **Agents** or to the realtime connection of external modules developed in other programming languages (validated experiences: **Java**, **Metacard**) as well as dynamic data exchange via for instance **ODBC** or **XML** interfaces. As mentioned in the previous section, it is also possible to use third party web development tools including Microsoft ones through data connectors such as **Proposion N2N** which enable .NET developers to access Notes Domino data and services from any .NET application and enables Notes/Domino developers to take immediate advantage of Microsoft .NET tools. Concerning user interface, Sametime provides connectors to integrate software agents intervening dynamically although implemented using different development platforms or languages (such as for instance, **Prolog**).

In particular, any specific **user interface** could be totally redesigned (on top of the ICDT Platform) to best fit the user needs using an **XML**/Flash solution such as the one documented in Appendix 1.

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See http://www.calt.insead.edu/eis/icdt.htm for a selected list of articles and book chapters related to the ICDT model.

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