A COLLABORATIVE MODEL FOR VIRTUAL ENTERPRISE

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Abstract

Collaborative process characteristics have three dimensions: actors, activities and action's logic. The aim of this paper is to present a virtual portal's model that helps managing consortiums. Our model based on dynamic e-collaboration and it has a modular structure, multilayer approach. System's functionality of virtual enterprise is collaborative model is concern on users' login, based on role and access control, searching and providing distributed resources, accessibility, metadata management and improved information's management. Our proposal for developing solution offers a functional architecture of a virtual enterprise using dynamic e-collaboration and shared space.

Keywords: dynamic e-collaboration, multilayer solution, modular approach

Introduction

Collaboration term has a lot of definitions, started with one of simple, based on ability "to work together, especially in a joint intellectual effort" [Er, 2000]. The term eCollaboration involve "the use of internet based technologies to enable continuous automated exchange of in- formation between suppliers, customers and intermediaries" [Donnan, 2002]. Collaboration can be "a long term development process in which actors (e.g., firms or individuals) first commit loosely both to each other and to pursue common purposes. As actors engage in these voluntary cooperative relationships, they learn gradually more about themselves and their counterparts and start taking actions and breaking boundaries toward collaboration, a tightly bound social *community* in which the collaborating actors are not only gaining business oriented objectives, but are also active participants of that *community* and construct meanings and identities in relation to that community" [Lehtimäki et al. (2005)].

*C*ollaborative process characteristics have three dimensions: *actors*, *activities* and *action's logic*. *Actors* are voluntary members, having commune interests, trusting each other and having the ability to collaborate. *Activities* are almost inter-personal or inter-organizational relationships. Activities are adapted to processes and formal and informal

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structures. *Action's logic* is based on long-term social inter-change, interaction processes, mutual agreed objective, terms, rules, mutual understanding, mutual hopes and positive expectances [Lehtimäki et al. (2005)].

Collaboration has a strategic role in company's business and collaborative relationships are the backborne for its operations. The business model is based on the network relations and outputs are created through collaboration [Matilla et all, 2007].

In this paper, we will present a virtual portal's model that helps managing consortiums. Second section is concerned on System's functionality, third section present virtual enterprise's collaborative model, started with global architecture and component modules, developing solution and functional architecture of a virtual enterprise. The last section is dedicated to conclusion and future work.

System's functionality

The system we propose has two parts. Firstly, it will include a virtual company's administration part, represented by a desktop application that will run locally, on the administrator's computer. Secondly, it will include a client application, represented by a web page that will run on a server and that clients could access from any location. The administrator will interact with the virtual company's data from the application's database to achieve metadata management, new resource search methods, and users' management. The application's library will contain files with information from different domains, proposed by project providers. The files will have different types (video, audio, images, text) and different formats (avi, mpeg, mp3, mp4, jpg,bmp, png, pdf, doc, txt). Library's information will be accessible for all project's members, and for other users as well. The access rights imposed for every user category will assure data's integrity. The project's members will have the right to copy, move and update data, while normal users will have restricted access.

The particularities of a virtual company are: *Users' login, Adding new users, Searching and providing resources, Accessibility, users ana metadata management and Improved information's management.*

Users' login. Any user can see and consult projects' content from the application's portfolio. To be able to download and have direct access to the files, a user has to login. Users can login on the Login page, introducing their username and password. *Adding new users.* If a user does not have a user account, he has to register himself, completing the form regarding his personal information. Information will be stocked in the database, after the software verifies if the user is a project member, project manager, provider or client. Depending on its role, he will get proper access rights.

Searching and providing resources. Users can search information in the virtual company and they can copy and alter files that interest them. Users will be able to search information introducing sorting criteria. The application allows complex interrogation. Files that mach criteria will be provided depending on their physical location.

Accessibility. We intend to make the application accessible for anyone having Internet access. Users should be able to run the application without installing other programs or plug-ins, by simply accessing a website.

Improved information's management. We propose different searching functions depending on users' type, role and knowledge about the wanted resource (restrictions for advanced search, simple search, access to digital library). We implemented a functionality that allows users to search using the category criteria. This allows the user to see all digital libraries' recordings that belong to a specific category.

Eased usability. The application will be easy to use for clients. It will have a personalized interface, including many options that could be selected. Users will have the possibility to return to a previous operation in the virtual company or the digital library.

Users' management. The database holds an evidence of the clients and the current members of a digital firm to ensure proper access rights for a client who wants an account. We considered that current members should have full access to information about the firm and information in digital library. They should have restricted access to information about the project they work on, depending on their roles. Users that are not members in a company should have limited access. They should not be able to download or copy any digital data about companies or projects and resources.

Metadata's management. The administration application allows users having administration rights to manage metadata. This means that the user will be able to add metadata to a specific resource, to modify existent metadata or to delete metadata (this operation is very rare, and generally it is made only after an achieve of database is made first). Every metadata has the following unique elements associated: title (alternate), coverage, date, and description. The administrator can see all registrations from the database that corresponds to these fields. He can also update fields' information. The administrator is the only user that can add or delete metadata. The project manager has the right to refine resources' subcategory. He cannot add or delete metadata because, generally, these elements depend, in a unique way, on a specific metadata, and because elements and associated metadata make sense only if they are taken together. For elements that have no metadata associated, administrator and project manager can update, modify, add or delete information, independently. These operations' effect can be seen, then, in the table that shows the database in the user application.

Resource categories' management. The portal provides a specific element, entitled Category, which is contained by the Project Administration's module. This element's role is to facilitate the resource search functions, allowing users to fulfill a searching field with the desired category. As examples for categories, we mention: distributed systems, mobile applications, artificial intelligence, and miscellaneous. A resource can be part of more than one category. Every resource in the database has an associated metadata from the distributed database, which specifies the category that includes the resource.

Physical resources management. The administrator has to manage physical resources that correspond to data from virtual enterprise's database and digital library. He also is in

charge with distributing resources to all network's computers. The application allows the administrator to add metadata for a specific resource. The metadata could be physically saved on any computer from the network that provides access to its information after a searching operation. Access to a resource means that a user, which needs it, has the possibility to save it on his computer.

Users' management. The portal must allow users' administration. This means that administrator has to be able to: add new users, delete a user, modify a user account and alter user rights. The operations must be executed in a secure environment, provided by a special created interface that requires a login before granting control.

Virtual enterprise's collaborative model

1. Global architecture and component modules

A brief description of the collaboration elements' characteristics, from the particular solutions offered by collaborative project management systems, could be resumed as follows:

- *Different relationship levels for the involved parts:* Business networks require different relationships and actors need diversified collaboration processes. On the other part, collaboration requires resources and time to grow.
- *Agreement and collaboration capacity:* Selecting the right partners depends on their willingness and ability to collaborate. Small companies strive to be part of collaborative processes but have inadequate resources, while big companies do not tend to invest in the first stages of collaboration.
- *Trust:* Collaboration is built on trust, having inter-personal relationships basis, even though on long term there is still a need for contracts. Trust is a variable element; thereby it is considered a treat for the collaboration process. Trust must be gained.
- *Communication:* Communication has a crucial role in collaboration. Central and main actors must consider both horizontal informational flows and vertical ones. Permanent communication assures real consistency in networking. The way the informational flow binds, to be short enough to avoid misunderstandings, imposes knowledge sharing.
- *Inter-personal relationships* are based on personal contacts, which are the collaborations heart. All company's challenges concerns who knows whom, and more than that, it takes time and resources to build strong relationships. One could say that a strong collaboration takes place between a small number of actors.

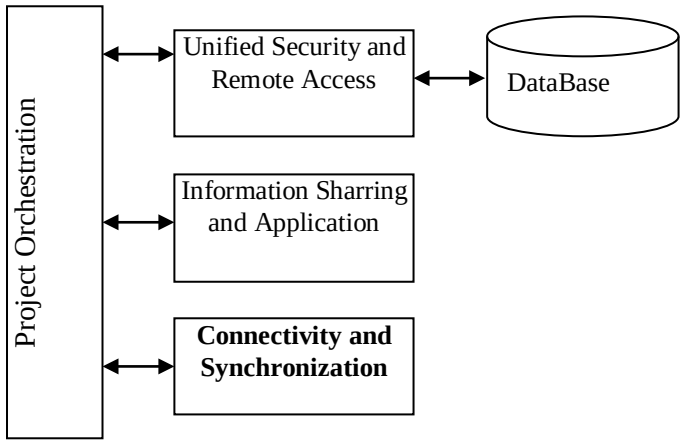

Figure 1. E-collaborative model for project management system

- *Shared interests:* are a must in a collaborative activity, because organizational and network's structure could fluctuate. Experts remain the same if their interests are well shared in a collaborative project.
- *Strategic orientation towards collaboration* is essential because collaborative relationships are crucial for operations that drive business for success. The business model is built upon these networked relationships, and the outcome is a result of the collaboration.

Collaboration model has three dimensions: roles, activities and action's logic. Analyzing collaboration's elements, in the light of the three dimensions, collaboration could be percept in three different ways. Firstly, collaboration with actors describes different levels of relationships between parts that collaborate. Secondly, collaboration with activities describes interpersonal relationships. And lastly, collaboration as action logic describes the strategic orientation in order to reach collaboration [Lehtimäki's et al. 2005].

2. Developing solution

Inter-personal relationships are an essential part of collaboration, generally, becoming collaboration's core. They affect other characteristics, directly or indirectly. All identified and analyzed collaboration's elements affects one-another, but it is considered that a collaboration is created, maintained and developed, based on inter-personal relationships.

In Figure 2, we have exemplified these principles, on a modularized structure, which could be grouped in two distinct parts: dynamic collaboration and shared space. Both of them are governed by a powerful administration module, which offers dynamic functionalities.

For developing this modularized proposed solution, we have respected the specifications from the 2009 phase report. The report includes key features concerning the formation, operation and dissolution of a virtual enterprise.

The *Partners' offers* module will be used to analyze client's requests. When a network partner confronts his self with a client's need, the first activity he should consider is to estimate if the network should provide such services. This means, he has to decide if treating the client's request is in network's best interest.

To select *proper partners* for the virtual enterprise, capability estimation is crucial. Most considerations concerning partners' selection were described in the anterior paragraph. Of course, the better the selection the easier the assembling phase of the virtual enterprise. Two modules manage this phase: *Individual offers* and *Competence and availability testing*. The two modules, together with *Partners' offers* will assure *a shared work structure*, managed by *Consortium selection* module. A shared work structure (WBS – Work Breakdown Structure) must be created in parallel with selecting partners. WBS caps the virtual enterprise's product decomposition in sub-processes that the selected partners must execute. The *Virtual enterprise formation* modules are divided according to a security solution for shared resources (*Security* and *Shared resources modules*). The formation process of a virtual enterprise includes: virtual enterprise's infrastructure definition, rules' definition, patterns' definition, definition of referential models that will be instantiated and contractual aspects solving.

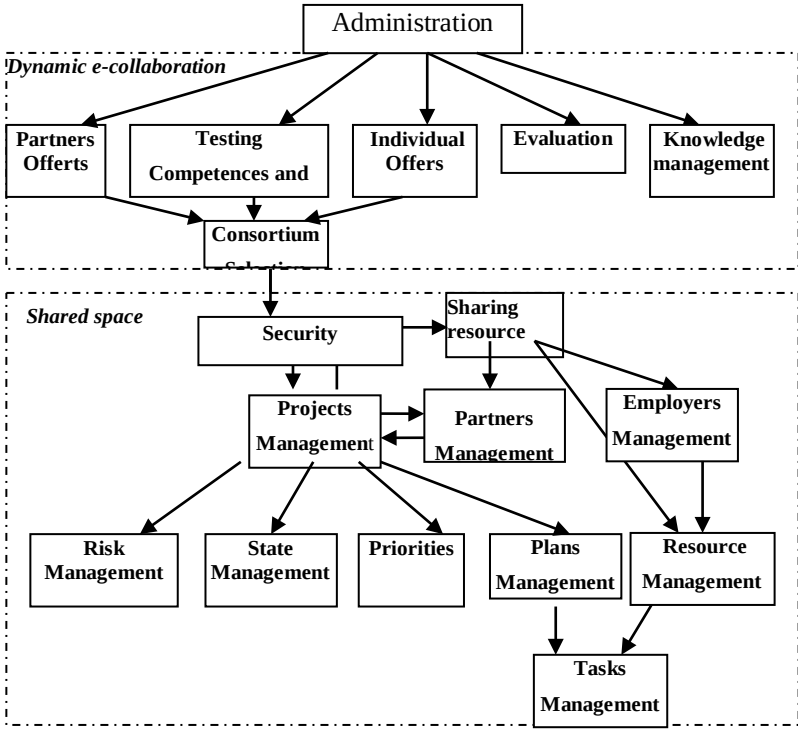

Figure 2. A model of dynamic e-collaboration

The project is monitored using the *Project management* module, which interferes with *Partners' management* and *Employees' management* modules. Project management activity contains specific module such as: *Risk management*, *Project's state management*, *Execution plan management*, *Resources management* and a specific *Priorities* module as well. The explication for this structure is the dynamic e-collaborative solution's specific,

the risks taken by partners concerning trust issues, the way collaboration works in the project, the needs and solutions that the developing methodology requires, etc. Using these modules, one can solve detailed planning issues, because every partner will have to make its own working program and decide if he should sub-contract some of his given tasks.

Virtual enterprise's management includes direct and indirect monitoring methods. *"Evaluation"* module assures the *Estimation and Monitoring* activities. Project monitoring and progress reporting are important management activities, which make sure that the project respects the budget and time limits. While developing the project, partners should estimate if some developed processes could be re-used for the current project or in other projects. Thus, the referential models are built.

Once the project finishes, *collecting experience* gained during the process will be a task for all partners. This desiderate can be accomplished using the *Knowledge management* module.

The portal provides five types of users: Administrator, Provider, Project Managers, Team Members, and Simple Users. Administrators manage users account, roles, user password modification, users report creation, user information export in XML, docx, excel, or other files.

Project managers create and manage projects. They could also estimate, decompose projects in tasks assigned to their collaborators. Partners accept and execute tasks, communicating evolution to the project's manager. In what follows, we will present portal usage aspects for every kind of user. For every instance, we will detail functionalities and describe implementation aspects. Every user will see the same header, footer and logout module but the menu will be different depending on their role.

User administration includes creating, deleting, altering, reporting and access granting functionalities. Only administrators can make the enumerated operations. Thereby, the administrators' menu includes the following options: Home, Reports and User Administration. Selecting *User Administration*, the portal will provide the associated page, engaging administrator to manage users and roles. Thus, he can consult the users table, grouped on categories, and information about users, such as: name, e-mail address, creation date, last login date, comments, etc

Project administration includes creating, deleting and modifying projects functionalities. Other related operations are task creating and proper users choosing. Project managers are in charge with administration's part (Figure 3).

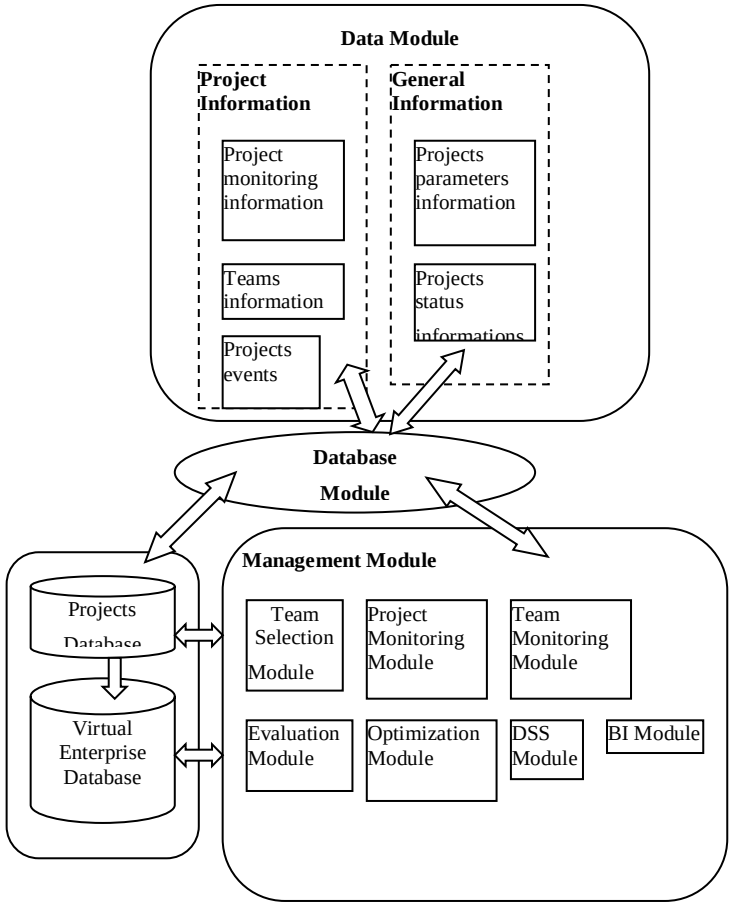

Figure 3. Virtual Enterprise structure and functionality

The specific menu for project managers include following options: Home, Manager Reports, and Projects. Choosing the Projects option a project administration page will appear. Here, managers can modify information regarding a project, create new projects, create and share new tasks for available users. Information about a manager's project will be displayed in a grid view. The grid contains specific, data such as: Project name, Description, Structure, Status, Goals, Objectives, Creation date, Schedule, Background, Motivation, Estimated duration, Completed, Edit Project, and Delete Project.

Task resolving includes functionalities related to member task administration and the communication between these and the project manager. Collaborative portal development requires three distinct parts: *Data module*, *Management module* and *Database management module. Data module* contains two distinct categories, *General Information* and *Project Information*, because every project is distinctly managed and has specific phases, activities and working teams. Project information includes: project monitoring

components, information about project's team, new tasks, associated events (deadlines, incidents, team changes), etc. General information refers to project's parameters and their states [Marmaridis, 2005].

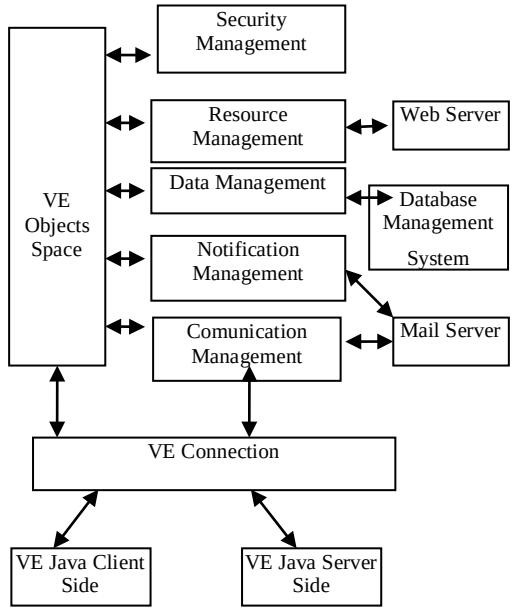

Figure 4. Virtual Enterprise Application Middleware

Management module provides several components that ensure virtual portal's functionalities. The components are: *Team selection component, Project monitoring component, Team monitoring component, Evaluation component, Optimization component,* and specific decision support system components and artificial intelligence components (DSS) as well. Lastly, *Management* module provides a Business Intelligence (BI) module. As a future development, we want to implement a *Knowledge management* component (Figure 4).

The moment a user logs into the system, as a project member, he will have access only at MyProjects section. The page will show him a table with projects in which he is member. Accessing MyTask option he will see tasks that were assigned to him, and there states (the completeness percentage and priority). User can modify tasks' states, and the system will inform the project manager. The system, also notifies user if the manager assigns him new task or if he is selected for a new project. When a task is completed, the user will set its state to *Completed*. A new task will have an implicit state *New*. When a user accepts the task, its status will become *Assigned*. While it is executed, its state will be *In Progress*. The completeness percentage will be shown always. Priority levels for a task are specified with numerical coefficients between 1 to 5, where 1 represents the highest priority. Simple users are not allowed to change priorities. This is managers' responsibilities (Figure 4).

3. Functional architecture of a virtual enterprise

Before the portal becomes functional on the Internet, a powerful security system has to be implemented, to assure information integrity and confidentiality. It is well known that users are not very careful, concerning their personal data. As the application and the administrator have full access to personal information, they, also, have the responsibility to secure their transmission, knowing the fact that this kind of information has a great value.

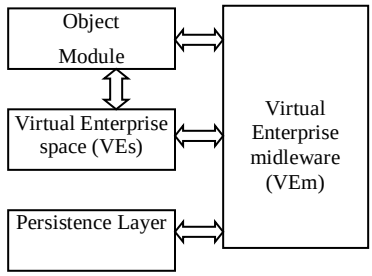

Figure 5. Virtual space (middleware)

The *Middleware solution* has been divided in three layers: Object and adaptors access layer, Application layer as middleware core and Persistence layer that uses a meta-framework to manage and describe content. These layers provide flexibility, simultaneous remote access, personalization, extension, new technologies integration and mobile perspective access (Figure 4).

Based on information provided by the VE object, this space includes special objects: observation and notification. For providing security and confidential access functionalities, remote communications and control, auto parameters feedback, we need middleware components like: security management, resources management, information management, notification management, and communication management (Figure 5).

As a practical solution for developing the portal, we propose a multi-tier architecture, which includes practical resources' orchestration solution in a collaborative manner. The Object Access Layer and the Adapter serve as object and service access solutions, depending on client's requests and observed parameters. Separating logical presentation and saved information, this layer provides facilities for object observation using notification services. All personal services run, based on object observers [Rusu et all, 2009].

The portal provides a shared object space. It requests a pertinent informational context, executes normal business process activities and sub-activities, and manages special events that appear in a project. The layer is based on standards and protocols as: HTTP and XML, Java Enterprise framework, Java Remote Method Invocation, Servers, Beans, etc (Figure 6).

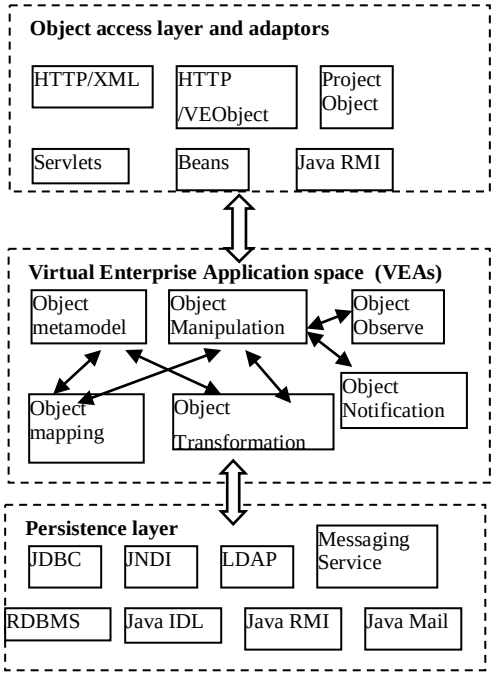

Figure 6. Relation between layers and VEAs

Conclusions

Our business model is based on the network relations and outputs are created through collaboration model in virtual enterprise and Marmaridis et all approach for dynamic e-collaboration.

We developed a modular solution based on system functionalities and task resolving which includes functionalities related to member task administration and the communication between these and the project manager. The portal provides five types of users: Administrator, Provider, Project Managers, Team Members, and Simple Users.

Collaborative portal development requires three distinct parts: Data module, Management module and Database management module, and functional approach is focused on three dimensions of collaborations: actors, activities and action's logic.

As a practical solution for developing, we propose a multi-tier architecture, which includes practical resources' orchestration solution in a collaborative manner. By separating logical presentation from persistence layer we saved information, and this layer provides facilities for object observation using notification services.

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