An Open System for Inter-enterprise Information Management in Dynamic Virtual Enterprises

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Summary

OSMOS, Open System for inter-enterprise information Management in dynamic virtual envirOnmentS, is a European RTD project aimed at the development of an Internet based environment that supports share of information and task collaboration between non co-located teams in the context of extended enterprises, and especially in project based industries such as construction. The OSMOS infrastructure is to provide services for communication, co-operation, co-ordination and data exchange, that will be possibly integrated with legacy or commercial software tools used within companies. OSMOS suggests a migration path from current document based information management towards semantic integration of documents, product models and project co-ordination information. Two OSMOS-based Internet services will be set up as pilots. Deployment of OSMOS compliant services in Europe will be promoted via user interest groups in several countries. The focus of this paper is on the presentation of the aims, objectives, approach, and benefits to the construction industry at large as envisioned through OSMOS.

Key words: Virtual enterprise, groupware environment, construction, information exchange

1. Introduction

1.1 Overview

IT in use in the construction industry needs to find the right balance between, on the one hand, integrated information infrastructures, tools and systems, and, on the other hand, the organisational peculiarities and complexities intrinsic to this sector. There is a need to support smooth co-operation between non co-located teams, and the co-ordination of their work and activities in an environment that promotes trust and social cohesion. This overall infrastructure should give construction project participants increased flexibility, and effective access to project information regardless of its form, format, and location. In order to address this wide scope, the OSMOS project is driven by the needs of end-users and the market, through the expertise of European leading construction businesses, including construction IT service providers, and European leading research centres. The project started in January 2000 and its duration is 27 months [1].

1.2 Objectives

The aim of the OSMOS project [2] is to enable European construction companies (in particular SMEs) to increase their competitiveness in the global marketplace through the promotion of Internet-based added-value services that support collaborative work in the context of the Virtual Enterprise (VE). The setting-up of these services should be made easy, short (from a few days to a few weeks), and most independent possible of the specific context of each company involved, in particular legacy or commercial applications in use.

This aim translates into the following objectives:

- specify and implement Internet-based services allowing management of heterogeneous information (especially semantic cross-referencing between information) co-ordination of interactions between individuals and teams in a dynamic construction VE;
- specify and implement a model-based environment where the release of, and access to, any shared information produced by actors participating in the VE is secure, tracked, and managed transparently, in the respect of their rights on this information;
- specify and develop a software architecture allowing integration of the above-mentioned services with legacy or commercial applications in use within participants of the VE;
- set up demonstration tools and a couple of OSMOS Internet-based team work pilot services, and ensure their take-up, as commercial offers, after the completion of the project.
- define the migration path to using the OSMOS approach, and analyse the likely benefits of adopting the OSMOS approach.

1.3 Consortium

The OSMOS consortium involves construction industrial partners (so called end-users), construction specific IT providers, and academic / research institutions drawn from four EC countries (Finland, France, Sweden, and UK). The mix of partners from industry and research ensures that a pragmatic approach is taken in OSMOS, that previous works and ongoing national projects are incorporated, that knowledge of standardisation and current research results are known, that real users are involved, and that solid development skills are available. In addition, national user interest groups have been set up in each of the above countries to ensure that OSMOS developments are directed by many of its potential users, and a commercially viable system emerges at the end.

2. Technical approach

The OSMOS project follows an incremental and iterative approach to address the above-mentioned objectives. The integrated OSMOS infrastructure, including the extensions to identified end-users' proprietary and commercial systems, will be the result of a series of iterations. It is planned that three iterations will be conducted during the course of the project. Each iteration has a duration of

nine months, and is used to assess and validate the OSMOS infrastructure, and address the potential risks in relation to the implementation of the proposed solutions. The important aspect is that change is anticipated at any stage of the software product lifecycle. The work is organised in the following packages, developed hereafter:

- Team work analysis and requirements capture
- Architecture definition and specification
- Infrastructure implementation
- Testing and evaluation
- Dissemination and exploitation

2.1 Team work analysis and requirements capture

The OSMOS project is driven by end-user requirements. A first essential workpackage is thus to produce a set of comprehensive requirements to be used as a basis for specifying the OSMOS generic solution. These requirements follow from an analysis of current business processes and information management practices within each of the three industrial partners involved in the project (Derbi, Granlund and JM). The stake is to understand current practices related to the establishment, maintenance and dissolution of a VE in the context of construction projects, as well as information flows and team work processes set up in this context, at all stages of the building lifecycle. A specific objective is to identify information inconsistencies and process inefficiencies currently taking place in collaborative work between non co-located teams on projects. In parallel, in order to understand the current partners' software and hardware infrastructures and requirements, a task is devoted to identifying common applications used within companies, and analysing their internal data structures and information requirements.

Based on this analysis, generic models have been developed to describe basic processes taking place in a Construction Virtual Enterprise. The kind of interactions between actors and teams has been described and modelled, along with the nature and semantics of the information being produced and exchanged. These models are basic underlying elements for the specification of the OSMOS solution.

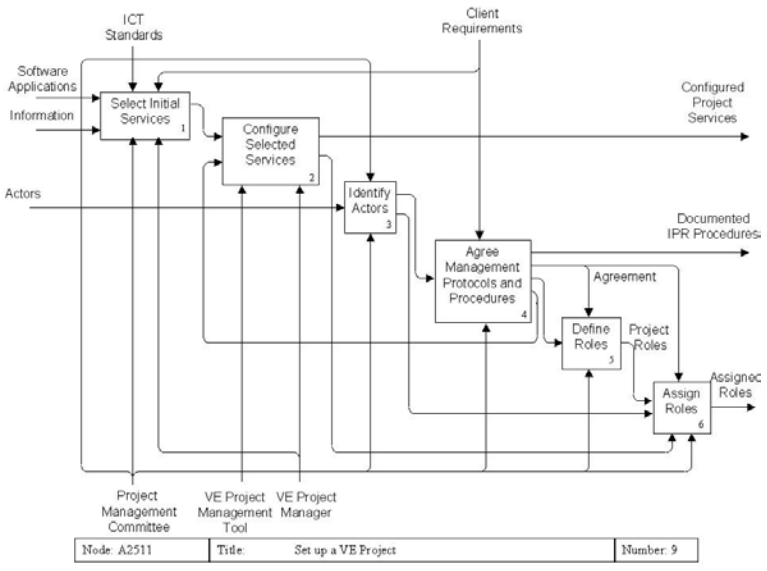


Fig. 1 An extract of the Integrated Generic VE Process Model

The core modelling component is the Integrated Generic Process Model. It gives a generic view of the various activities required to operate a VE project. The opposite figure shows an extract of this generic VE process model, expressed with IDEF0 diagrams. It describes the setting-up of a VE project.

It should be noted that the lower levels of these diagrams are translated into Use Cases descriptions for the specification of the OSMOS solution.

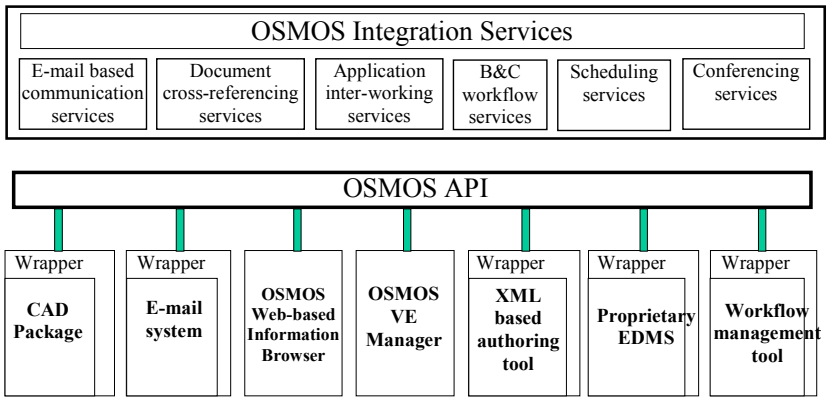
2.2 Architecture definition and specification

The specification of the OSMOS solution is derived from the requirements analysis carried out at the previous stage of the project. The objective is to give a detailed specification of the basic system

architecture underlying the OSMOS solution, along with its main components (semantic models and specific OSMOS services with their API) and the specification of required extensions to the chosen and identified legacy and commercial applications to be further connected to the OSMOS infrastructure (*wrappers*).

As a first step of the specification work, the selection of the underlying software and hardware technology of the OSMOS infrastructure started from an overview of potential emerging information and communication technologies, and team work services. Confronted with architectural and technical requirements expressed through end-users' business processes, it led to preliminary choices for communication, co-operation and co-ordination technologies that are meant to be further refined during the three-steps iterative process adopted in the project (see an adjoining paper for more detailed information on these technologies).

The OSMOS modelling infrastructure is a major component of the architecture. It supports logical and semantic structuring of information for the VE and therefore enables and supports team work in a secure and controlled environment. Efforts have been put on the integration and harmonisation of existing models rather than development of new models. The main results are an OSMOS Distributed Object Management Model (to manage actors, ownership, rights, responsibilities, versioning of information, change notification, etc.), and a Semantic Multimedia Document Model (to handle documents at the required level of granularity).



The opposite figure introduces a generic functional architecture of OSMOS supporting co-operation between a variety of commonly used application in a construction VE. It is worth mentioning that the OSMOS Integration Services, and associated API, are not supposed to be all implemented.

Fig. 2 The OSMOS functional architecture

During the course of the project, a subset of them will be identified and specified as being more suited to the specific business and information requirements of a Virtual Enterprise in construction. For the first project iteration, an "e-mail based communication service" and a "document cross-referencing/information management service" have been specified and implemented.

2.3 OSMOS infrastructure implementation

This work package of the OSMOS project focuses on the implementation, in an incremental manner, of the OSMOS services based on identified project end-user proprietary and commercial applications. Development and provision of these services are on the basis of models developed in the previous work package (specification). The work done in the first iteration of the project with respect to this work package has been on the setting-up of the OSMOS service providers and on prototype and extensions implementation.

Different services have been developed and extensions to end-user proprietary commercial applications made. The services include an e-mail based communication service, document cross-referencing/information management service, etc. Here we however provide a short summary of two of the prototype service tools developed, the virtual enterprise manager (VEM) and the web-based information browser (WIB). These tools will be demonstrated in an adjoining paper.

The OSMOS VE Manager is the tool used by the administrator of the VE system. It provides a set of functions, implementing a subset of the OSMOS Integration Services, enabling the setting-up and management of a VE. The basic functionalities of the VEM as provided in the demonstration

include:

- ability to create, modify, update (register) VE participants (actors);
- ability to create roles and assign these roles to actors;
- ability to create objects and object classification;
- ability to add methods (services) to an object and to make these available to different roles.

The OSMOS Web-based information browser (WIB) is the main entry point into the OSMOS system. The core objective of the WIB is to expose different objects to actors holding roles that have authority to browse these objects. At the same time, the WIB exposes those services that are available to the actors for invocation. The basic functionalities of the WIB as provided in the demonstration include:

- ability to retrieve and make available different objects to an actor to which he/she has rights based upon the role he/she chooses to participate in;
- ability to make available those services to an object to which the actor's chosen role has access to;
- ability to pass on queries to external services based on selected object and associated method.

2.4 Testing and evaluation

The OSMOS project evolves around many field trials as a way of testing and validating its approach. These field trials play a crucial role not only in the validation of the build and installation of the technological systems but also in development of the organisational and business recommendations. More specifically, the OSMOS business strategy is based on the identification and implementation of the changes resulting from the proposed OSMOS approach. The integration of the human, organisational and technical elements of the change throughout the project is a prerequisite for a successful specification of the strategy. Factors which are often neglected and which will be included in the industry/business analysis are:

- business circumstances of the organisation;
- overall strategic plan, organisation structure;
- existing procedures, practices and systems;
- design of jobs;
- skills of project actors (managers, specialists, clerical and field employees) and plans for training and development;
- company culture;
- nature of process of developing and updating technology and extent to which future users are involved;
- design methodologies and project management;
- composition and effectiveness of project teams;
- state of industrial relations and human resource management.

The evaluation of the field trials that have taken place so far indicated that OSMOS approach can improve communication and co-ordination of construction projects. This iterative and incremental methodological approach showed that there are certain characteristics which need improvement such as speed and training. On the other hand, the evaluation results indicated that the organisations have the potential to evolve and adapt to a virtual environment.

2.5 Dissemination and exploitation

The focus of this work package is on the dissemination and exploitation of OSMOS results.

Dissemination of the results is achieved through papers, conferences and workshops, which have and will include events staged for specifically targeted interest groups. Additionally, a web-based

demonstration describing the project overall approach and summarising the results will be provided at the end of the project. Furthermore, User Interest Groups (UIG) have been set-up in Finland, France, Sweden, and the UK respectively. These will help in the dissemination of OSMOS results with the potential of extending and making available the findings to industries other than construction.

Exploitation of OSMOS results is to be through three main routes:

- establishment of Internet-based groupware operational service providers in Finland and France;
- establishment of a European Network of AEC groupware service providers;
- promotion of the OSMOS API by actively participating in national and international bodies, including the IAI, and OMG..

3. Expected Achievements/Impact

The OSMOS project is specifically concerned with defining the working practices, processes, techniques, tools and technical infrastructure to allow the European construction industry to progress from its current position towards a large scale, computer integrated approach. As such, it is an industry-led project involving construction end-users, construction IT providing companies, and academic and research organisations. Each of these groups has a very important, complementary role to play in the exploitation of the OSMOS project results. In addition, the role of the User Interest Groups will be to assist in the wider dissemination of the OSMOS results, and to ensure that they are sufficiently generic to be transferred to industries other than construction. It is expected that some of these organisations will be interested in adopting the Internet-based team work services support offered by the OSMOS partners, and spread the resulting practices across their organisation, and business partners.

4. Conclusions

This paper presents the OSMOS project in large, focusing on the objectives, work organisation, technical approach and first results obtained halfway through the project. More details on the models, tools and services developed so far are given in an adjoining paper. We put here the stress on the fact that the project is driven by end-users' requirements. The iterative process allows to have periodic feedback from end-users and thus control that the proposed services correspond to their needs. That includes validation through field trials and measurement of business and organisational changes required to adapt to the Virtual Enterprise approach.

The main expected result from the OSMOS project is an Internet-based environment that provides services for efficient management of controlled business processes in the framework of open Virtual Enterprises in the construction sector. One of the original features of OSMOS is to promote collaborative services that can be easily and shortly integrated to applications and information systems in use by the various participants of a VE, including SMEs.

5. Acknowledgements

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6. References

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