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Proposed OSMOS intra-company information process model

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Summary

This document is the second iteration version of the Proposed OSMOS Intra-company Information Process Model. It is the outcome of the work carried out in Task T1100: Business Process and Information Practices Analysis. The focus of the report is the current business processes within the three OSMOS end-user organisations. It should be read in conjunction with its sister documents D1.2: Proposed OSMOS Inter-company Process Model, and D1.3: Construction Common Software Applications Analysis. Summaries of the aims, and the impact and links of Workpackage 1 and Task T1100, are followed by descriptions of the OMSOS requirements capture methodology and the proposed OSMOS Framework. This is followed by in-depth analyses of the current business processes within Derbi, Granlund and JM. One further update of the report will be released at the conclusion of Workpackage 1 in the third iteration of the project.

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Abbreviations

API	Application Programming Interface
CAD	Computer Aided Design
CORBA	Common Object Request Broker Architecture developed by OMG
CSCW	Computer Support for Co-operative Work
EDMS	Electronic Document Management System
FM	Facilities Management
HTML	HyperText Markup Language
HVAC	Heating, Ventilation, Air-conditioning
IAI	Industry Alliance for Inter-operability
ICT	Information and Communication Technology
IFC	Industry Foundation Classes developed by the IAI
LSE	Large Scale Engineering
OMG	Object Management Group that develops the CORBA standard
OSMOS	Open System for Inter-enterprise Information Management in Dynamic Virtual EnvirOnmentS
PDM	Product Data Management
SGML	Standard Generalised Markup Language
STEP	Standard for The Exchange of Product model data
UML	Unified Modelling Language
XMI	XML Metadata Interchange
XML	eXtended Mark-up Language developed by W3C
XSL	eXtended Style Language

VE	Virtual Enterprise
WP	OSMOS Workpackage
WWW	World Wide Web
W3C	World Wide Web Consortium

1. Introduction

The objective of workpackage 1 (*State of the Art and Requirements Capture*) of the OSMOS project is to produce a set of comprehensive requirements to be used as a basis for specifying an OSMOS generic solution to enhance the capabilities of construction enterprises to act and collaborate effectively on projects.

The aims of the workpackage (WP) translate to:

- Understand the business processes and information management practices of the end-users involved in the project.
- Analyse and model the dynamics of the interactions taking place between actors and multi-disciplinary teams at all stages of the building lifecycle.
- Identify common applications used within the building lifecycle, and analyse their internal data structures and information requirements.
- Identify the information flows of any kind within the building lifecycle.

To achieve these aims WP1 is structured into the following three tasks:

- Task T1100: Business process and information management practices analysis
- Task T1200: Analysis of interactions between teams on projects
- Task T1300: Common construction applications analysis

The work carried out in the workpackage (WP) included an analysis of the current business processes and information management practices within the project end-user organisations – Derbi, Olof Granlund Oy (Granlund) and JM AB (JM). An analysis of the type and nature of inter-company interactions taking place on multi-disciplinary construction projects within the end-user organisations followed this. Finally the set of tools commonly used on projects was identified, with an emphasis on the understanding of their internal data structures and information requirements. These analyses are presented in the OSMOS deliverables D1.1 (*Proposed OSMOS intra-company information process model*), D1.2 (*Proposed OSMOS inter-company process model*) and D1.3 (*Construction common software applications analysis*) respectively.

This report – D1.1 "Proposed OSMOS intra-company information process model", is the second iteration deliverable for Task T1100 (*Business Process and Information Management Practices Analysis)*, and reflects the analysis work undertaken within the task.

The end-users from Derbi, Granlund and JM have taken a predominant part to this work package. The outputs have mainly been driven and derived from the end-users' personal know-how and experiences on projects. From the analysis of current business processes and information management practices, and the inter-company interactions within construction projects generic models have been developed to describe basic processes taking place in a Construction Virtual Enterprise (VE). These models form the underlying elements for the specification of the OSMOS solution in WP2. WP1 has also identified information inconsistencies and process inefficiencies currently taking place in collaborative work between non-collocated teams on projects. 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.

Chapter 2 of this report highlights the impact of WP1 in general, and TaskT1100 in particular, on the remaining project workpackages. This is followed in Chapter 3 with a brief description of the process description methodology and its application within Task T1100. Chapter 4 presents the OSMOS Process Framework, identifying the contribution of Task T1100 within the Framework and links to other project tasks. In Chapters 5, 6 and 7, the overviews of the business process analyses of Derbi, Granlund and JM respectively are presented. Each chapter includes a presentation of the company and its overall business mission, a description of the core business processes, a description of current information management practices, identification of any existing inefficiency, and finally a summary of the company's vision within the project. Chapter 8 concludes the report. There are four Appendices attached to the document for reference purposes.

2. Impact and links of T1100 on the overall project

The OSMOS consortium has adopted an iterative and incremental approach to address the objectives of the project. The project duration is 27 months, with the work being carried out across three iterations (of nine months each). Each iteration allows the consortium to assess and validate the OSMOS infrastructure, and address the potential risks in relation to the implementation of the proposed solutions. Figure 1 graphically represents this approach.

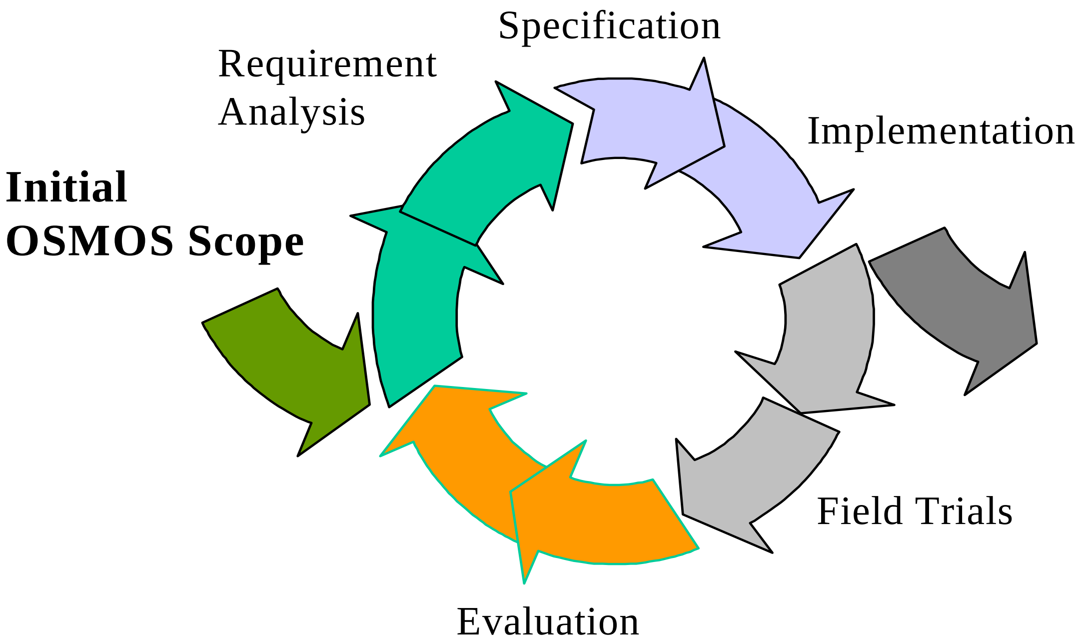

Figure 1: OSMOS Iterative and Incremental Approach

A single iteration of the project is carried out across six workpackages, which are interdependent, providing feedback in a cyclical manner. The workpackages are:

1. WP1: *State of the art and requirements capture*
2. WP2: *Architecture definition and specification*
3. WP3: *OSMOS infrastructure implementation*
4. WP4: *Evaluation and organisational recommendations*
5. WP5: *Dissemination and exploitation*
6. WP6: *Project management*

WP6 is an ongoing task throughout the project, and WP5 is ongoing since the production of the first results from the project work. Workpackages 1 to 4 fit closely to the components of the model in Figure 1.

The initial OSMOS scope was based on the need to specify internet-based services for collaboration and co-ordination of interactions, in a model-based environment, allowing end-users to employ their proprietary and commercial applications on projects. Furthermore was the need to support teamwork in dynamic networked organisations, taking into account social, economic and legal aspects. Requirement analysis for the proposed system was provided by the analysis of current business processes and information management practices within the end-user organisations. This led to the development of models describing the basic processes taking place in a construction VE. These models are basic underlying elements for the specification of the OSMOS solution in WP2, and its implementation in WP3. WP1 also identified information inconsistencies and process inefficiencies currently taking place in collaborative work between non-collocated teams on projects. This information provides input to the evaluation of the system and organisational recommendations in WP4. The structuring of the work into workpackages offers a pragmatic way for implementing the OSMOS objectives and performing the required work. Figure 2 shows how the workpackages and their tasks map onto the incremental and iterative approach.

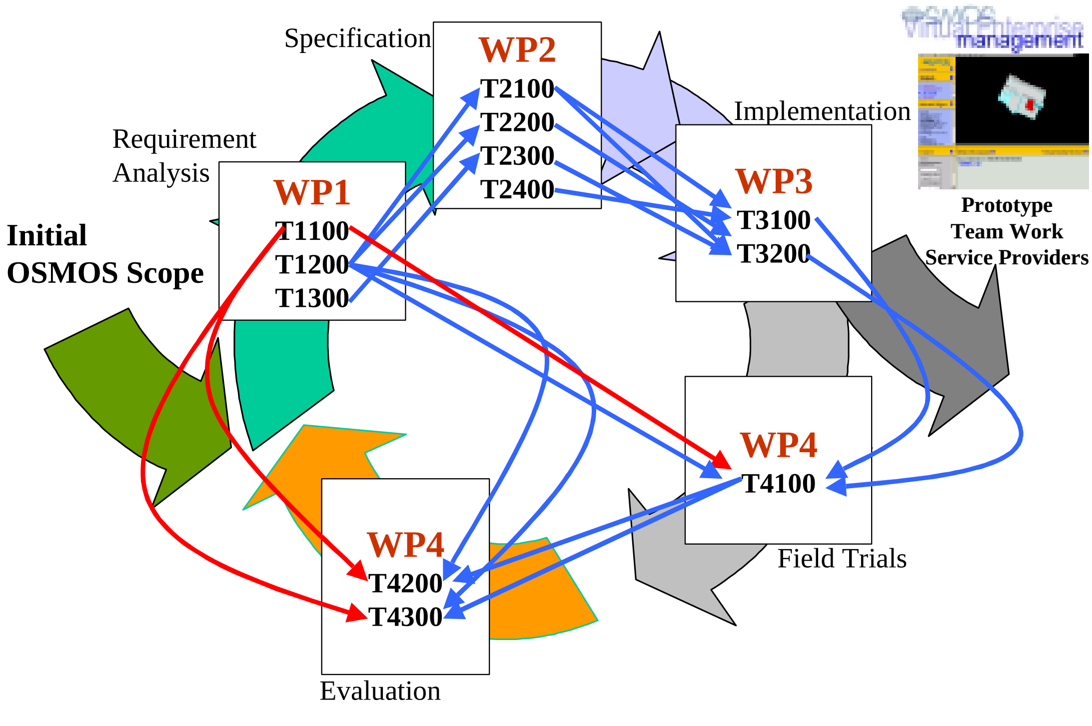

Figure 2: Mapping of Workpackages onto the OSMOS Approach

It can be seen from Figure 2 that the work carried out in WP1 impacts directly on WP2 and WP4, and indirectly on WP3. The task reported in this document (Task T1100), specifically impacts all three of the tasks within WP4. By taking into account the methods currently employed in terms of business processes and information management practices, and the proposed methods of correcting information inconsistencies and process inefficiencies, the field trials of the OSMOS system can be clearly defined in Task T4100. Equally, the work in Task T1100 provides a yardstick for evaluation of the field trials in Task T4200. Task T4300 of WP4 aims to define the strategy to implement the changes resulting from the OSMOS approach, and the results from the Task T1100 requirement analysis (combined with further research instruments) form the basis of such recommendations.

Task T1100 also has a direct link with Task T1200 and, therefore, deliverable D1.2. Based on the models provided by each end-user company (see Appendices 2, 3 and 4, and deliverable D1.2 Chapter 5), a proposed Generic VE Process Model has been produced to describe the perceived processes required to operate a VE under the OSMOS approach. This model is presented in Chapter 7 of deliverable D1.2.

In keeping with the ethos of an iterative and incremental approach to the development of the OSMOS solution, it must be pointed out that this report details the results and methodological practice employed up to and including the second iteration of the project. Naturally, the ongoing work in the subsequent workpackages of iteration 2 will impact on to the final WP1 for iteration 3. A further revised and updated version of this document will be delivered in the third iteration of the project.

3. OSMOS Requirement Capture Methodology

In iteration 1 of the OSMOS project, an internal document was produced explaining the proposed requirement capture methodology and the rationale behind this choice of methodology. This document was distributed to the end-user organisations as the basis for the reporting of their current business processes, information management practices, and commonly used software and hardware. The document included templates designed and proposed to facilitate the description of the end-users' practices as well as the ICTs supporting their core business processes. A copy of this document has been included at Appendix 1 to the current document.

In terms of the migration from initial requirements capture to internal design and API of the OSMOS system, the methodology includes the following elements:

- Core business oriented process models
- Process models describing team working on projects in organisations
- Generalisation of, and abstraction from the above, leading to the development of a proposed OSMOS Generic Virtual Enterprise Process Model
- Architecture specification (WP2)

As stated above, the process models were provided by the end-user organisations, based on their current working methods in the construction industry. In iteration 1 of the project it was found that the templates provided for this analysis caused some confusion between the end-users, resulting in information being supplied in varying formats. This situation was further complicated by differences in understanding between the terminology used by the academic/research partners, and the industrial end-user partners. For the second iteration an example format (initially provided by Granlund) was suggested for each of the end-users. This allowed the information to be captured in a relatively standardised format for analysis and direct comparison by the academic/research partners. The resultant models provided a comprehensive view of the intra- and inter-company business activities and the methods of information handling between actors. To compliment this analysis each end-user also provided an analysis focused on teams/actors management in the context of a VE.

Figure 3 below shows an annotated example of the format used for the analysis. This format allowed the end-users to present their current processes as IDEF0 diagrams, and to include additional information as required. This information included a description of the activity being modelled and the operational context in which it is applied. Additionally, the actors involved in the activity, any existing pre-conditions and/or post-conditions, exceptions, and other remarks pertinent to the activity could also be provided.

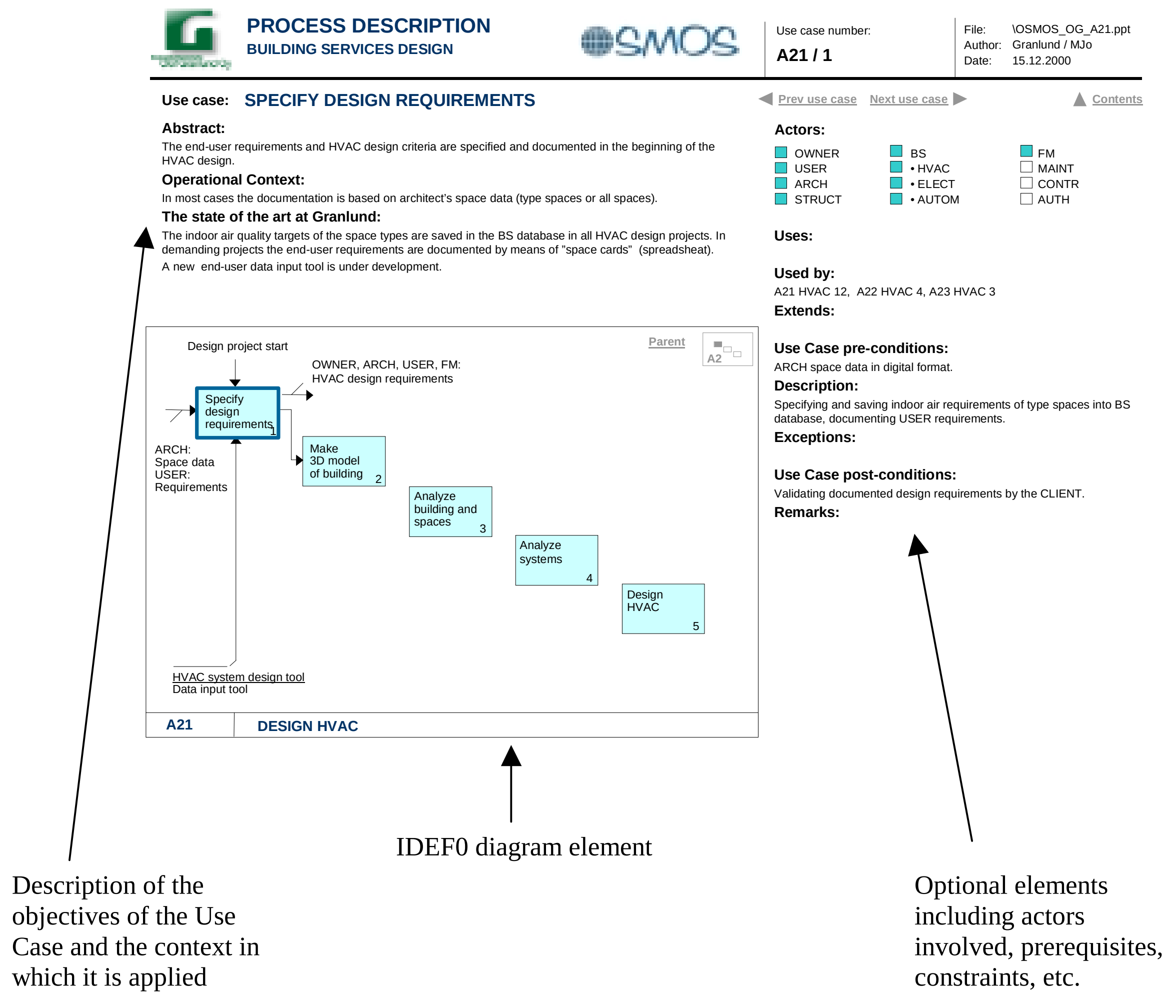

Figure 3: Suggested Format for Process Analysis

The complete IDEF0 models of the three end-user organisations' business processes are presented in Appendices 2, 3, and 4 (Derbi, Granlund, and JM respectively) of the current document. The formalised process models were enhanced with textual overviews for each company, which are presented in Chapters 5, 6, and 7 of the current document.

The next element in the OSMOS requirement capture methodology – the Generic VE Process Model – was designed based on the results of the foregoing analyses. By abstracting from the current business processes, the higher level activities expected to be required in a VE were defined. The Generic VE Process Model produced in the first iteration was revised and each of the end-user organisations produced IDEF0 models analysing their current VE practices. The results of this work are presented in Chapter 5 of deliverable D1.2, and the second iteration revision of the proposed Generic VE Process Model is presented in Chapter 7 of the same document.

The Generic VE Process Model provides the basis for the necessary Use Cases required to describe how the OSMOS system can be used at a business level, and to derive the required functionality of the system. The ensuing Use Cases are the bridging link between the requirement capture in WP1 and the system specification in WP2. Figure 4 illustrates diagrammatically the methodological link between the two workpackages.

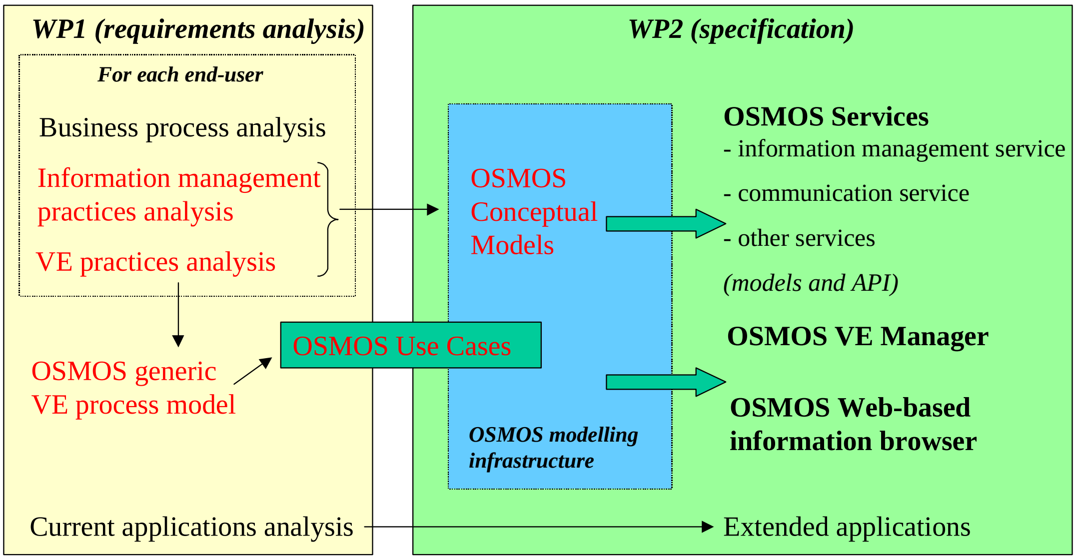

Figure 4: Links and Impact of the methodology between Wp1 and WP2

With the Use Cases defined, the technical specification within WP2 can be completed employing the UML techniques of sequence diagrams and class diagrams to specify the internal system design. In parallel to the internal design specification and from the analysis of construction common software applications (deliverable D1.3) the set of interfaces to be implemented between the various software applications and the OSMOS architecture will also be defined. The result of this work will be the final element of the methodology – the OSMOS API.

4. Proposed OSMOS Process Framework

As mentioned above, the objective of WP1 is to produce a set of comprehensive requirements to be used as a basis for specifying an OSMOS generic solution to enhance the capabilities of construction enterprises to act and collaborate effectively on projects. The lifecycle of the OSMOS VE, therefore, has to take into account the set of processes that occur throughout the complete construction lifecycle. It is of great benefit to the aims of the project that the three end-user companies (Derbi, Granlund and JM), whilst specialising in differing areas of the construction lifecycle, together embrace the complete building process from conception to maintenance. Figure 5 diagrammatically represents the scope of the three end-users within the construction project lifecycle and the mapping of the activities within WP1.

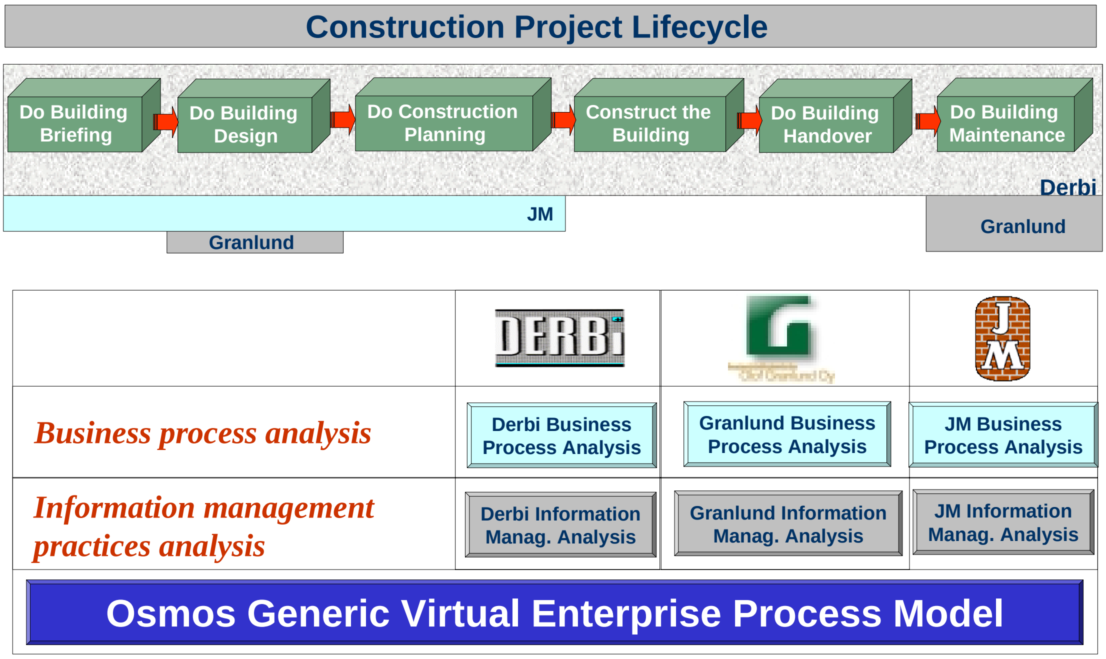

Figure 5: OSMOS Process Framework

The top section of the diagram represents the traditional building process, along which the areas of specialisation of the three end-users are indicated. Each of the end-user organisations is described in further detail in Chapters 5 to 7, together with their core business processes. It is important to note here, however, that the scope of the three companies differs in terms of their personal know-how and experiences on projects:

Derbi / OTH: Derbi have a crucial and strategic role in the OSMOS project in that they are supporting the whole OTH group in terms of ICTs. Moreover, the scope of Derbi is wider than that of OTH. Derbi aims to develop generic solutions that can be potentially deployed in any Construction organisation in France. Based on their wide and valuable knowledge acquired through decades of collaboration with the different subsidiaries of the OTH group, as well as their business partners (Architects, clients, contractors, etc.), they have decided to conduct a wider analysis of their core business processes. Therefore, Derbi has analysed the entire lifecycle of a building project.

Granlund: As the leading building services consulting firm in Finland, Granlund specialises in the design of HVAC, piping, electrical, building automation, security, telecommunications systems and technical facilities management (FM) services and software. In this capacity Granlund's focus in the OSMOS project is on technical FM.

JM: JM is currently the fourth largest Construction Company in Sweden. Whilst JM has always been a construction company, its activities have now expanded to include real estate and property management. JM’s focus in the OSMOS project covers the period from the acquisition of land until the planning of the construction phase in a housing project. The exclusion of the construction phase can be justified by the fact that JM is not always in charge of this phase.

The next layer of the diagram in Figure 5 represents the Business Process analysis and Information Management analysis phases in the three end-user organisations. This section of the Process Framework is covered in the current document, reporting Task T1100.

The third layer represents the development of the OSMOS Generic Process Model, derived by abstraction from the analysis of VE practices currently undertaken within the three organisations. This section of the model is realised through Task T1200 and is detailed in deliverable D1.2.

The individual scope of each of the three end-users is also important in terms of the development of the OSMOS Generic Process Model, and indeed the final implementation of the OSMOS solution. It has been recognised through detailed consultation and reaffirmation of the vision of each of the companies’ aims and objectives within the OSMOS project that there are three potential roles within the OSMOS VE model. The three roles are:

1. Role A – OSMOS Service Provider. This role will be taken on by a company wishing to provide the complete OSMOS VE system and services.

2. Role B – Third Party Service Providers. Companies taking this role will provide services that will plug in to the OSMOS system.

3. Role C – OSMOS Clients. This role includes any company that will sign up to the OSMOS VE Service to run a project.

These roles and their relationships in the context of the OSMOS solution are depicted diagrammatically in Figure 6, below. The Role A company (OSMOS Service Provider) offers its web-based VE service to Role C companies (clients) via the internet. Role B companies offer their own applications and services to Role C companies through the OSMOS API. This allows the OSMOS clients to receive a complete VE management service that is customised to their specific project requirements.

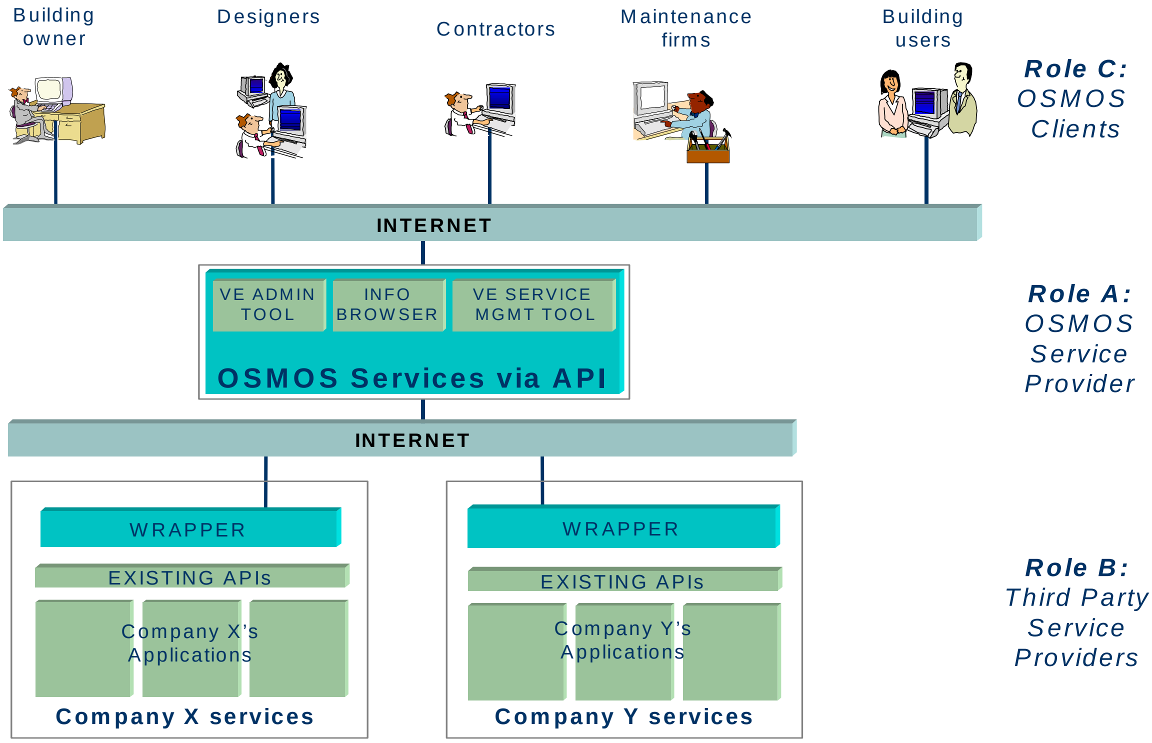

Figure 6: OSMOS Model and Proposed Roles

With regard to the OSMOS end-user organisations, it is envisaged that Derbi may ultimately take on the role of an OSMOS Service Provider (Role A company), and also that of a Third Party Service Provider (Role B company). Granlund would be a potential Role B company, offering the services of applications such as Ryhti and Riuska (see deliverable D1.3), whilst JM may become an OSMOS Client (Role C company) using the VE service to increase the efficiency of their building production (see Chapter 7).

5. Business process analysis overview in the construction sector in France detailed by Derbi

5.1 Presentation of OTH and Derbi

OTH (Omnium Technique) is an engineering group specialised in building engineering. With more than 600 employees, OTH is one of the most important engineering companies in France.

Derbi is the OTH subsidiary that was created to provide the group with software and computerised services, to improve its efficiency.

Due to its expertise in the building engineering field, Derbi is also providing services for projects in which OTH does not take any part. Essential references include the European Hospital Georges Pompidou, The European Parliament of Strasbourg, The Monaco Congress Centres, where the SGT Electronic Document System (described below) was used to manage the entire project documentation.

The fields of engineering carried out by OTH cover all the services a major engineering design firm can offer for building, infrastructure and industrial operations:

General engineering design services

These services cover the design work for all building trades and construction supervision, from the schematic design phase through commissioning of the works.

Specialist engineering design

These techniques concern specific building trades:

- Structural works- Civil engineering works
- HVAC
- Utilities
- Electrical engineering and electro-mechanical equipment
- Building cabling, communication and information systems
- Finishes
- Cost estimating and budget control

Specialist subsidiaries of the OTH Group

- Urban and regional planning and development, urban and hydraulic engineering, the environment, civil works, power generation - OTUI
- Owner assistance and building programming - Costing - PATMO
- Operation and maintenance engineering - OTHEM
- Construction management - Project management - COPIBAT
- Coordination of worker health and safety - COSSEC
- Data processing - DERBI

The particular role that they play in OTH Group allows Derbi's teams to express the business processes at each stage of a construction project.

5.2 Derbi's overall business mission

DERBi is engaged in three main fields of activity:

1. Research and the design and development of software applications: DERBi designs, develops and markets software applications, primarily in the construction domain. These applications include:

- A system for exchanging documents and sharing data, and including project management functions for the monitoring and follow-through of construction projects: SGTi (Graphic and Technical Server), providing both a software application and a service for construction companies on projects (as regards the management of the entire documentation produced and used),
- A specific management system for producing and updating drawings during both the design study stages and the final co-ordination work (GPP),
- A maintenance management program, BATHMAN,
- Property management applications (PATRI and SIP: a Property Information System).

DERBI are also heavily involved in research and development projects, and have participated in several national and EU projects. These include:

- Study of the automation of call to tender procedures and follow-up,
- Study of the consistency of computer-based production of project documents (Condor project – ESPRIT 23105),

- Study of the possibilities for implementing an Internet solution in the low-income housing field,

- Synthesis of the present state-of-the-art of project management software (from the point of view of clients/owners), on behalf of ADP (Aéroport de Paris).

Derbi's services cover all or part of the following tasks: analysis of requirements, preparation of specifications, definition of the data processing architecture, establishment of data models, drafting of functional specifications, development, documentation, testing, implementation, training and follow-up.

2. The setting up of computerised solutions for producing and exchanging data: Derbi participates actively in organising CAD and computerised communication solutions. This involves all or part of the following services:

- A study of requirements and the design of an information and production system,

- The methodological organisation of an operation and the writing up of the corresponding documents,

- Supply and installation of computer equipment, software and networks,

- Operation of the systems set up,

- Training, project accompaniment, and follow-through,

- Maintenance and telephone assistance.

Derbi ensures the same services for other types of projects, including property management operations. These services may be complemented by additional tasks, such as input assistance. Derbi is also an accredited training institution.

3. Handling of the final co-ordination phase of an operation: Derbi's services in this field cover management of the final co-ordination work, conducting site meetings, supervising draftsmen's work, the setting up of an information system for data exchange, and of a production system for the final co-ordination drawings.

The most successful service developed and promoted by Derbi is named SGT (Serveur Graphique et Technique – Graphic and Technical Server). SGT is an EDMS, with additional services that are typical to the construction sector. SGT was first developed before 1995 to address OTH needs with regard to data exchange and storage between the actors of a building project.

At the time, SGT was based on classical client/server architecture. Setting up and deploying SGT was often complex and too expensive for small and medium projects. It could be used only if the total amount of works was in excess of 25 M€.

The new version developed in 1999 and 2000, named SGTi is fully compliant with the Internet technology. The aims now are to make it possible to use the SGTi system in any project regardless of its size; to propose additional functionalities; to give more autonomy to end-users during the creation and management of their VE; to allow easy deployment; and to provide better value for money for clients and actors on projects.

5.3 Description of business processes in the construction sector in France

The analysis lead by Derbi consists of producing diagrams to represent the business processes observed during the building lifecycle.

This formalism makes it possible to identify the mechanisms that are used to organise the collaborative work (in the wider meaning) between the actors of a construction project.

As an EDMS provider, Derbi already addresses some of the actors' needs, but only at certain stages of the lifecycle. In order to give the largest scope to the OSMOS project, it was necessary to analyse, first, the business processes themselves, without depending on the tools that are used by the actors. The second step of the analysis deals with the most common tools.

For the purposes of the OSMOS project, Derbi has therefore selected a period that goes from the inception of a construction project (the idea of creating a new building) to the achievement of the construction itself.

Once the building is achieved, the actors that have a relation with the building may be different. Granlund (see Chapter 6) addresses this scope.

The selected period is divided in 6 main stages:

1. Preliminary studies and brief stage

2. Design work and specifications

3. Contractor selection

4. Worksite preparation and organisation

5. Construction works

6. Completion and commissioning

Each stage is detailed through several business processes. This analysis of course is not exhaustive. But it certainly offers a very large overview of the technical, administrative and financial aspects of construction projects, and covers the most important interactions and exchanges between actors.

The IDEF0 diagrams detailing these six phases are presented in Appendix 2.

It is important to note that SGTi services, or any similar extended EDMS, is generally set up during the work site preparation (stage 4 in the general building process). Sometimes it is set up earlier, during stage 2: Design work and specifications.

There is no available service in France that would cover the exchanges from the beginning of stage 1 to the end of stage 6, and offer added-value services to the actors.

5.4 Description of Derbi's information management practices

The analysis of the business processes detailed in Appendix 2 shows that information management mechanisms during the design phase, the contractor selection and the construction works are very different.

Trying to characterise the main features of these mechanisms, we observe the following principles:

<u>Design phase</u>

This generic phase covers the Preliminary studies and brief stage and the Design work and specifications, which means the whole design process. During the design phase, architects and engineering design offices carry out collaborative work in order to produce files. A file, being a schematic design, a detailed design or tender documents, is a set of documents that must have a technical, financial and administrative coherence.

A file is really achieved once the owner, the legal authorities and the building control authorities validate it.

One document itself may be the result of collaborative work: for instance producing an HVAC drawing uses the architect drawing of the same zone as a component. The input data becomes a component of the result. Moreover, the work is often iterative, in so far as the architect modifies its drawing to include the HVAC constraints.

Two fundamental features arise:

- the actors need a "project account" in which they store their work in progress and their achieved work, and
- their production tools have to be compliant at a deep level.

The use of a CAD standard, indeed, is not sufficient. Of course, it will solve the problem of putting the HVAC layer on the architect's drawing, but it will certainly not help the actors (architect and engineering team) to find the coherence between their drawings and their textual description.

Another example to illustrate the needs of the actors during the design phase could be the following. A door is drawn on the architect drawing, specified in a textual description written by an architect or an engineer, and listed in a cost estimation established by an economist.

Three standards are involved: a CAD standard for the drawing, usually MS Word for the textual description, and MS Excel or other specific software for the cost estimation. If the architect removes the door from the drawing, the file immediately loses its coherence, although the actors use the same standards.

Because of this, the OSMOS model must distinguish the integrity of a file, which is an issue dealing with the documents (the file contains all the expected documents), and the coherence of a file, which is an issue dealing with the information contained in the documents.

If we assume now that the completion of a file is solved, the question arises of how to characterise the mechanism used to produce the file.

A file production is a controlled process in which the design actors aggregate components (information and documents), and play alternatively the role of a resource or a constraint. The file is then submitted to the owner and to different authorities who do not modify the contents of the file, but validate it or not. A validation is actually a list of advice, some parts of the file are accepted, and others are refused.

There is no added-value service on the market dealing with these controlled processes, either they include external authorities or they do not.

The services identified in the design phase analysis are:

- Project account with “light” EDMS functions to organise and share documents
- Cross-referencing, at the level of a document to ensure integrity and at the level of the information to ensure coherence
- Specific workflow to manage production, and pass all the check points successfully, eventually including in the VE authorities that are external to the design team

<u>Contractor selection</u>

During the contractor selection (tender), the design team no longer produces files.

The potential contractors prepare their answer to the tender.

The first problem for the owner is to provide the potential contractors, which may be numerous, with the tender documents. There is a significant waste of paper in producing sufficient copies, while only one contractor will be selected for each technical part of the construction.

The VE could be open to all tenders and then reduced to the contractor, because keeping all those who are tendering in the VE is useless.

It is important to note that the procedures are different between public and private tenders. In a public tender, the administrative file is very important and the documents required by the owner are always the same. There should be one general registration of these documents for each company once a year in order to avoid this inefficient systemisation. In a private tender, the procedure is lighter.

In all cases, the tenders have to get a file, and to produce a file containing administrative, technical and financial information.

The services identified are:

- Register information about each company
- Modify easily the VE directory
- Publish documents (tender documents) and receive documents (contractors' bids).

<u>Construction works</u>

During this phase, architects and design officers, who were previously involved in a production process now act as authorities to control and validate the contractors work.

The main processes are:

- Approvals on documents and samples
- Meetings involving all the actors and leading to decisions consigned in minutes.

The information contained in the documents does not have same importance. A contractor produces a precise drawing that will be used on the construction site; the architects and engineers analyse and validate this drawing without using its content to produce anything else.

The workflow is much easier to define than for the design phase: it is essentially a question of approvals on documents.

Due to the number and the variety of actors and contractors, new needs appear. It is now necessary to define the contractual links between the actors (sub-contractor for instance) and to allow all the actors to meet easily.

These needs correspond to the following services:

- "Intelligent directory" clarifying the contractual links between actors
- "Intelligent diary" to facilitate meetings organisation.

The contractual links between actors are especially important for the financial aspects.

5.5 Identification of current information and process inefficiencies

While expressing the business processes with the IDEF0 method, Derbi has identified different kinds of process inefficiencies for which an improvement is expected in the OSMOS project. At the present level of the study, there are three major kinds of inefficiencies in the solutions Derbi can propose to organise virtual enterprises: the set-up complexity, the risk of non-added value services, and the limited capacities in terms of services.

The complexity of the set-up process is more a reaction of the users than a technical problem remaining unsolved. Setting up a VE with SGTi requires a methodology led by an EDMS consultant and meetings with the construction project management (which means the owner, the architect and the engineering design teams). There is no default configuration to immediately address the needs of the actors. Once the methodology is achieved, a certain level of autonomy is given to the VE administrator who generally belongs to the construction project management. But transferring the VE management from the provider to the administrator cannot work without teaching the administrator how to manage the system.

The actors themselves have also to be taught how to carry out their own tasks on the system. If the project is not located in Paris, this means that the actors have to come to Paris, and a training room is created close to the project location and used by the EDMS consultant. These are unacceptable constraints because actors are looking for plug and play services.

There are different solutions available on the market to provide actors with a "project account" in which they would organise their collaborative work. Most of these solutions can be defined as the virtual office concept, which is easy to use but does not include specific added value services dedicated to the construction sector. A solution to these inefficiencies may be a light SGTi version, integrating more and more services thanks to the OSMOS methodology.

This statement makes the second inefficiency visible: it is necessary to provide actors with a large number of services. In their current practices, Derbi has tried to imagine links between SGTi and Internet sites, but this would not give the dynamic effect expected by users.

A more open and large view is to be founded within the OSMOS integration methodology. The result of the integration is a larger offer to the user that invites him to remain a client, and that is evolving according to his evolving needs.

The risk of non-added value services, which is the third kind of noticeable inefficiency can be divided in two classes: non-added value service due to the functionality itself, or non added-value service due to the way users manipulate the system and diverge from the original aim of the functionality.

To ensure that functionality is added value services, it is important that they are based on information and documents standards used. Some functionalities are at the level of documents (creating files with different documents), others are closer to the production tools. Each time production tools are involved, a standard must be used, and XML will be studied to sort out the risk inefficient functionality.

Non-value added services might also result in incorrect use of the system. For instance, architects often complain about EDMS because they have the impression that it tends to produce an artificial number of document indexes, while the number of different versions is less important in the case of a paper production (especially for drawings). This statement means that services promoted and integrated in OSMOS must diffuse an acceptable quantity of information to the user.

Here is also an important issue for the reengineering process, and how to help users adopting the proposed tools.

5.6 Derbi's vision: Aims and Objectives in OSMOS

Derbi's vision of OSMOS, as was expressed in the initial proposal, was to offer a nation and European wide service aiming at effectively supporting communication, co-ordination, co-operation and documentation on projects. This would enable existing and potential SGTi users to use the OSMOS communication platform not only for exchanging data with partners, but also for retrieving data from external databases in a wide range of areas. At the beginning of the project, Derbi were aware that they needed to extend the capabilities of their existing proprietary systems, and to take advantage of the latest IT developments to remain competitive. Support for workflow is one of the main functionalities required on EDMS. Further to this is the need to control the internal semantics of the documents that are managed, originating from a variety of software applications, including SGTi in a more global platform, integrating a set of commonly used commercial applications, to address the information needs of construction virtual enterprises today.

The analysis produced in the present document and the commitment with the OSMOS partners have made it possible to give a more precise definition of what is to be done.

The business process analysis and the IDEF0 diagrams methodology have led Derbi to a classification of the issues. Separating the design phase and the construction phase is necessary to list the needs of the actors that are slightly different at each phase. Since SGTi is actually used in the building phase only, there is an opportunity for Derbi to address a larger scope, and to provide SMEs with low entry-level tools, while Derbi's tools were previously dedicated to big projects.

Therefore Derbi has decided to set up a platform including the VE Manager developed in OSMOS, SGTi and the e-mail server developed by CSTB. It is actually a light version of SGTi that will be used. This version "SGTi for SMEs" will offer a "project account" that is easy to set up and manage, and progressively include more functionality.

This platform will make it possible to realise field trials dealing either with the design phase or the building phase.

New functionalities, especially cross-referencing and workflow, will be specified and developed within the OSMOS model and contribute to extend the capacity of the OSMOS API to interface new services.

Moreover, Derbi and CSTB have signed a protocol during the 13th month of the OSMOS project to be industrial partners in Interbat, which is expected to be the most important portal for the construction sector in France. Interbat also has a European ambition, and the results of the OSMOS project as a research project will find here a possibility to become an industrial offering.

6. Granlund's Intra-company business process analysis overview

6.1 Presentation of Granlund

Granlund is the leading building services consulting firm in Finland. It is specialised in the design of HVAC, piping, electrical, building automation, security, telecommunications systems and technical facilities management (FM) services and software.

The company was founded in 1960. Today, Granlund employees about 250 building technology professionals in the head office in Helsinki and subsidiary companies in Finland (Lahti, Kuopio, Tampere and Vaasa) as well as in Tallinn, Estonia.

The company's turnover in 2000 was approximately FIM 85 million, of which 8% came from exports.

Granlund's focus in the OSMOS project is on technical facilities management. The company's Windows based Facilities management software (RYHTI) has been sold for about eight years. There are currently about 150 RYHTI installations with between one and twenty users in each. The customers, mainly building owners, are from Finland, other Scandinavian countries, UK, Germany, Hungary and some other countries.

6.2 Granlund's overall business mission

Granlund is active in all the sectors of the building services field, covering the entire life cycle of buildings - from programming to design, commissioning, facilities management, condition surveys and renovations. Granlund's services are supported by remarkable contributions to development of design methods, data management and interoperable software tools. The company's approach is based on continuous collaboration with customers and on data management that covers the entire useful life of buildings.

The building data management is based on storing design data in databases during the design process and utilising this information in design, construction and quality control during installations and commissioning. When the building is completed, the databases are handed over to the clients for computer-based facilities management.

Although Granlund's objective in the OSMOS-project is targeted on developing web-based Facility Management services, the process descriptions include the main services provided by Granlund during the whole building lifecycle – from early design to facility management. Describing the whole lifecycle process aims to clarify Granlund's fundamental concept of using data generated from the design process during different stages of the building project and transferring as-built data to facility management systems.

6.3 Description of Granlund's core business processes

Granlund's process descriptions are presented in Appendix 3. The top-level model (A-0: OSMOS VE Process model) describes the data management process (A1: Establish and maintain OSMOS VE) as well as the core business process (A2: Manage BS design and FM).

The business process model (A2: Manage BS design and FM) comprises the *current* Granlund design methodology including the usage of computer-based tools and data exchange. The implementation of the model in various design projects varies depending on several factors such as project size and nature, customer needs etc.

6.4 Description of Granlund's information management practices

Granlund's current internal design information management practice is based on storing technical data in facility-level databases on the company's internal servers. HVAC designers and also electrical and building automation designers use these databases during the design process. Thus the databases have a central role in integrating the different design disciplines and ensuring information consistency. The databases are set up at project start by using a custom project management tool. Document management is based on an internal application; both CAD and textual documents are stored on internal servers. When the design project is finished both the database and the documents are transferred to the customer's servers. Granlund's facility management system (Ryhti) is compatible with the database and can also be used to manage the transferred design documents.

The internal design information management system is not described in detail because Granlund's objective in the OSMOS-project is targeted on developing web-based Facility Management services.

The current inter-company design information management practice is mainly based on exchanging design documents through Internet-based project servers. Commercial companies provide these project storage services and contracts for using such services in design projects are usually made by the building owners as part of the project set-up. Granlund is currently not providing project document storage services and has no intention to do so in the future. Information management is based on transferring documents by HTTP or FTP and the systems provide basic document management features. Advanced document management features such as workflow are currently not commonly used in building design projects.

The current information management in FM-systems delivered by Granlund is based on normal client-server architecture. Facility management data, both databases and documents, are stored on the customer's (i.e. building owner's) servers and accessed through workstations connected to the LAN or WAN. The users include maintenance departments, building users and external maintenance companies.

The process model in Appendix 2 (A1: Maintain and establish OSMOS VE) describes information management for design and facility management in a *future* integrated Internet-based environment. The model describes the OSMOS concept from Granlund's point of view and is the company's goal for developing a web-based FM system. It also forms the base for business discussions that currently take place between Granlund and its business partners in order to set up a consortium for offering web-based building services. For Granlund it is, however, equally important that there are several different integration models and environments because the Internet and business models based on it are under constant and rapid evolution.

6.5 Identification of current information and process inefficiencies

The current FM-systems delivered by Granlund are based on client server architecture and are thus problematic in large, geographically decentralised environments. Large installations can contain several thousand buildings at many different locations that are maintained by a centrally located maintenance organisation supported by local service personnel. Currently such cases can be handled only by dividing the building database into several smaller sub-databases that are merged back to the main database at regular intervals. Such a practice is error prone and leads to a lot of extra work.

Quite often building owners need to give limited access to the FM-system to external consultants for a shorter period. This is often the case in smaller renovation projects where facility data has to be updated. Currently such arrangements are problematic and lead to temporary solutions that are usually not efficient.

Large installations are also problematic from a maintenance point of view. Software updates have to be installed on all workstations connected to the system, a process that is both expensive and time-consuming and heavily burdens the IT-support personnel.

The current FM systems are also primarily aimed at professional FM-users. They have a rich set of features, which lead to a rather steep learning curve. Thus they are not well suited for more occasional use by, for example, ordinary building users. This leads to problems in implementing services such as help desks.

6.6 Granlund's vision: Aims and Objectives in OSMOS

Granlund's objective in OSMOS is to exploit the support and results of the project in setting up new web based business consortiums with business partners in Finland and in other countries. Granlund also aims to develop web services and software tools based on the idea of integration and life cycle data management of buildings. Granlund's focus in OSMOS is primarily on technical facility management (FM) and other special services.

From Granlund's perspective it is important that the integration models are flexible enough to offer several different alternatives both for degree and method of integration in a variety of environments. Granlund is not interested in taking on the role of OSMOS integration provider hosting the virtual enterprise integration services, the main interest lies in providing special web-based building services as a member of a larger consortium. Such a consortium would consist of several companies co-operating and complementing each other in the same information management environment. From the customer’s (i.e. building owner’s) point of view, the main benefit of such an integrated consortium is a homogeneous environment providing new web-based services for the complete building lifecycle.

7. JM's Intra-company business process analysis overview

7.1 Presentation of JM

Since its formation JM AB (JM) has always been a construction company, which has now expanded its activities to include real estate and property management.

JM has been a public limited company since 1982, and is today the fourth largest Construction Company in Sweden. The company counts approximately 2,200 employees and concentrates its activity in Sweden and the Stockholm area, but also has some offices outside Sweden (in Belgium, Denmark and Norway). JM is the market leader in Sweden in housing construction, and in this area JM acts as a project developer and building company.

JM is one of the main actors among the non-purely real estate companies for the Stockholm area. As a building and construction company, JM focuses its work on projects of residential and commercial premises and is also active in industrial constructions, civil engineering and maintenance.

7.2 JM's overall business mission

JM is characterised by foresight, planning and action for the long term. Its strategy is to focus its activities on long-term projects and investments. JM aims to enhance its role in project development operations in order to benefit from the synergy between the real estate and construction activities.

Housing construction comprises more than fifty percent of the company's building production, for which JM has production and marketing responsibilities. Project development is also conducted via the two wholly owned subsidiaries, AB Boratt (in charge of providing its customers with attractive, functional and environmental friendly homes) and Seniorgarden AB (in charge of housing for the elderly). Construction operations include contracting and civil engineering operations, the subsidiary AB Projektgaranti (which undertakes construction and supervises appointed contractors) and a group of painting firms. As a general principle, JM requires 70% of the planned flats to be sold prior to the start of construction. The current production is around 2,000 flats per year.

7.3 Description of JM's core business processes

The description of JM's core business process (presented in Appendix 4) covers the period from the acquisition of land until the planning of the construction phase in a housing project. The exclusion of the construction phase can be justified by the fact that JM is not always in charge of this phase. The description has also been restricted to the study of housing projects and the business process diagrams have been elaborated for an "average" project. This means that some slight changes can appear in the business process depending on the intrinsic characteristics of the project.

The described business process is divided into three main stages: Project Planning, Building Design and Construction Planning. Each stage is then subdivided into two or more processes. The diagrams describing JM's core business processes are presented in Appendix 4: JM's detailed intra-company business process analysis.

7.4 Description of JM's information management practices

Most clerical workers at JM use digital management for the documents they create, which makes management more efficient. Management is technology-based i.e. there is a great demand for accessibility. Documents are stored on a centrally located server. Each employee has a home directory on the server and it is also possible to have shared directories for projects with several users. In addition to this there is also an internal archive/project database that is accessible to everyone at JM through the Intranet. Document searches make it possible to spread information and increase the amount of experience-based feedback. This means that as many JM employees as possible need to take advantage of this system for optimal effect.

E-mail is often used to distribute documents in a construction project. Most parties consider this as a quick and convenient way of information sharing. E-mail is always open and users do not have to log in with passwords. External databases are used to a certain extent for storing and distributing documents, especially drawings. These are primarily used for larger projects and are sometimes administrated by one of the consultants in the project group. When external databases are used, JM often has little to do with drawing management. Record drawings for projects are usually delivered on CD to facilitate archiving for buyers, who in many cases are private individuals or associations that do not have access to more advanced storage options. A viewer often accompanies the CD to make it possible to review the drawings in plt-format.

One in five of all consultants hired still draw in analogue form. This means that JM personnel must work in two systems, one analogue and one digital. Analogue management is done using binders and drawing gallows. Many contract notices are sent in analogue form. Many suppliers and contractors hired by JM also work in analogue form. Documents are sent by messenger or through the mail.

Use of external databases varies greatly at JM. It is often only in large projects that one takes the time to start an external service in which all of the project's document management, scheduling, etc. is done. For smaller projects, it is often only drawing management that is linked to an external database so that everyone can access and download the files. This service is often offered by a participant in the project group, such as the architect, or is purchased from smaller companies in the construction industry. Larger suppliers are seldom used for this type of project as they often have more complicated and expensive services because they offer more functions. Start-up and administration of the database is often handled by the external consultants since it is often used only for drawing management, which JM does not handle in digital form, especially if no viewer is offered.

Larger projects use more extensive databases since they require more comprehensive functions. These can include setting authorization levels, common calendar functions, plotting drawings, document histories, viewers, e-commerce, etc. This leads to higher costs, which are acceptable because more functions, greater storage space and better security are offered in return. Storing documents in an external document pool gives the project manager / design manager more control over the documents than previously.

7.5 Identification of current information and process inefficiencies

Today there are several systems in use at JM for information storage. In many cases the same document can be saved multiple times by different users, all in the same project and working at JM, on different locations. This often leads to problems, not only for taking up large amounts of disk space, but also with versioning control between the users when there has been an update of the document. Versioning control is of great importance for the quality work in construction projects. There are currently no connections between the different internal information storage systems.

In cases when external databases are used people often find these expensive and that they are both difficult and time consuming to work with. At present there are no connections between external databases and internal information systems at JM.

There is often a lack of information control in the design face. If the design manager doesn't have access to a CAD-tool he is cut of from some of the information exchange between the consultants and has only to rely on paper drawings. It is possible to use simple CAD-viewers (which can often be downloaded for no charge) for drawing management, but in most cases they do not work sufficiently and do not support both the plt- and the dwg-formats.

The most common tool for exchanging information is the usage of email services. Email, as a tool is fast, easy to use and requires only a short set-up time in a project. It does, however, neglect various functions to work satisfactorily, such as scheduling etc, and cannot act on its own as a project network.

There is a need for a system where all project information can be stored and be accessible for all participants in a project, regardless of whether the information has been created internally or externally. The user must also be able to view the information regardless of the software in which it was created. The system also needs to be easy to use since there are great variations in computer knowledge among the users, both at JM and among the external consultants working for JM.

7.6 JM's vision: Aims and Objectives in OSMOS

There is no existing company regulation that leads JM's work with external document management, but the process today is under redesign in order to find improvement and a more homogeneous way of working. As stated above, the most common tool today for exchanging information is the usage of email services, which are subject to the limitations outlined.

From an IT development point of view within the construction market, JM needs to move towards more effective information and communication systems, which also have the integrated functionality of an EDM system. This is in order to enable easier access to and more control of the information in a market that is moving towards more decentralised, and even global, organisations and project groups. In these systems, the refinement of information and communication by using intelligent IT tools is very important. JM believe that such a system would make our building production more efficient.

8. Conclusion

This report presented the results for the second iteration Task T1100 (*Business Process and information Management Practices Analysis*), forming the first part of WP1, which aims to produce a comprehensive set of requirements to be used as the basis for specifying the OSMOS generic solution.

Chapter 1 recalled the aims and objectives of WP1, and described the work carried out in Task T1100. Chapter 2 highlighted the impact of WP1 in general, and Task T1100 in particular on the remaining workpackages and tasks. This was followed in Chapter 3 with a presentation of the OSMOS requirements capture methodology indicating the strong link between WP1 and WP2. In Chapter 4 the OSMOS Process Framework was presented along with the proposed OSMOS roles and their impact on the modelling of the Generic VE Process Model. Chapters 5, 6 and 7 presented the business process analyses from the three end-user organisations. These analyses, accompanied by the IDEF0 models presented in Appendices 2, 3 and 4 form the first phase of the requirements capture for the proposed OSMOS system, feeding in to the modelling development presented in deliverable D1.2.

A final version of the document will be produced in iteration 3 of the OSMOS project, reporting the necessary future analysis as the project progresses.

Acknowledgements

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Appendix 1

OSMOS Requirements Capture Methodology (Iteration 1)

This document proposes a methodology for process description aimed at the OSMOS end-users, namely: Derbi, Granlund and JM.

Adhering to a consistent and common process description methodology would help to a better understanding of the requirements of the OSMOS infrastructure. This will result in a more accurate specification of the required solution.

1. Introduction

The work involved in WP 1 consists of, firstly, the analysis of intra-company business processes, and information management practices based on the project end-users. This will, then, be followed by the analysis of the type and nature of inter-company interactions taking place on multi-disciplinary construction projects, with a strong emphasis on contractual, legal and IPR (Intellectual Property Rights) aspects underlying this collaboration. Finally, the set of tools commonly used on projects will be identified, with an emphasis on the understanding of their API, interfaces and communication mechanisms, and their information requirements.

Workpackage1 will produce comprehensive requirements based on current business processes and information management practices within Derbi, Granlund and JM. Based on this analysis, generic models will be developed to describe the processes that take place in a VE. *The kind of interactions between actors and teams will be described and modelled, along with the nature and semantics of the information being produced and exchanged*.

2. Proposed Methodology

Two complementary approaches will be used to comprehend the end-users business processes, and help to capture the requirements of the OSMOS system. IDEF0 will be used to define high level process activity models describing the business processes and information management practices taking place in the building process, within the OSMOS end-users companies, and also between partners on a construction project, i.e. at level of inter-companies communication (Figure 1).

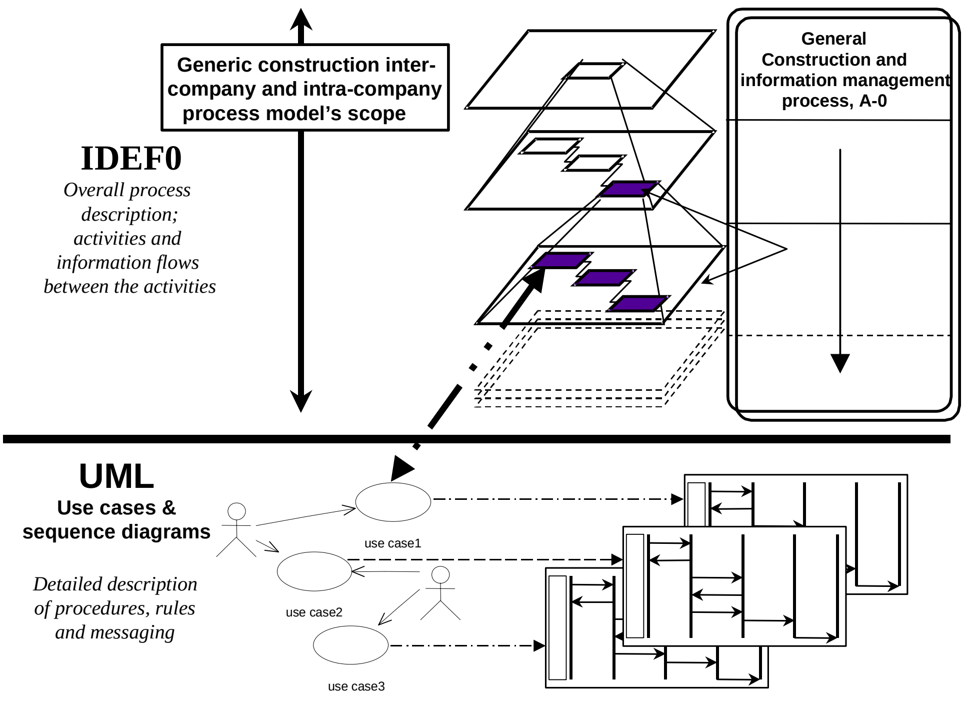

Figure 1: Proposed methodology for capturing the requirements of the OSMOS infrastructure.

A set of **Use Cases** (Unified Software Development Process, from Jacobson, Booch, and Rumbaugh), at a lower level, will be specified to detail the different ways in which the OSMOS system is to be used.

The specification phase should be split as follows:

- IDEF0 diagrams and Use Case descriptions (through context diagrams and textual descriptions, see section 3.1) deal with the user requirements, i.e. the expression of needs.

- In a second phase, refinement of the Use Cases will be realised, especially through Sequence diagrams used at the level of analysis/conception (these sequence diagrams could be potentially related to class diagrams).

The first step has to be realised by the end users, describing user requirements through a static view (context diagrams for Use Cases, extended by textual descriptions) and a dynamic (sequential) view with IDEF0 diagrams. In the second step, a system analysis will be provided, with a static model (class diagrams) and a dynamic model (sequence diagrams). It will be done by the architecture designers (WP2) and *validated by the end users*, and will strongly relate on results from the first step, with extensions and evolutions in order to comply with the OSMOS approach and operational context. In a third step comes the design of the computer-based solution, i.e. the system architecture and components specification (in WP2).

Thus, the expression of the end users needs distinguishes:

- **The context diagram**, that defines the context of the system to operate, i.e. actors, potential passive external entities, and action/reaction between the system and the actors (expressed using oriented labeled arrows), along with the identification of possible specific (physical) interfaces (i.e. smartcards, laptops, etc.). Actors must be identified, that are entities such as a human being, a machine or a system or sub-system supposed to interact with the system. The actor can consult or modify the state of the system, but in no case is a passive actor (except explicitly mentioned): the system is supposed to give an answer to the actor. In OSMOS, the context will be fully defined through (1) the identification of the list of actors, and (2) a unique **context diagram** (*Note: there can be several context diagrams, if totally disconnected*).

- **The Use Case description**, that reports in a textual way a set of interactions realized by the system and that produces a (value-added) result to a specific identified actor.

After realising the formulation of IDEF0 diagrams and Use Cases, the next stage is to describe in detail all the transactions involved in implementing every single identified use case. This will be done via interaction / **sequence diagrams**. Figure 2 illustrates how IDEF0 is used in conjunction with use cases and sequence diagrams from UML.

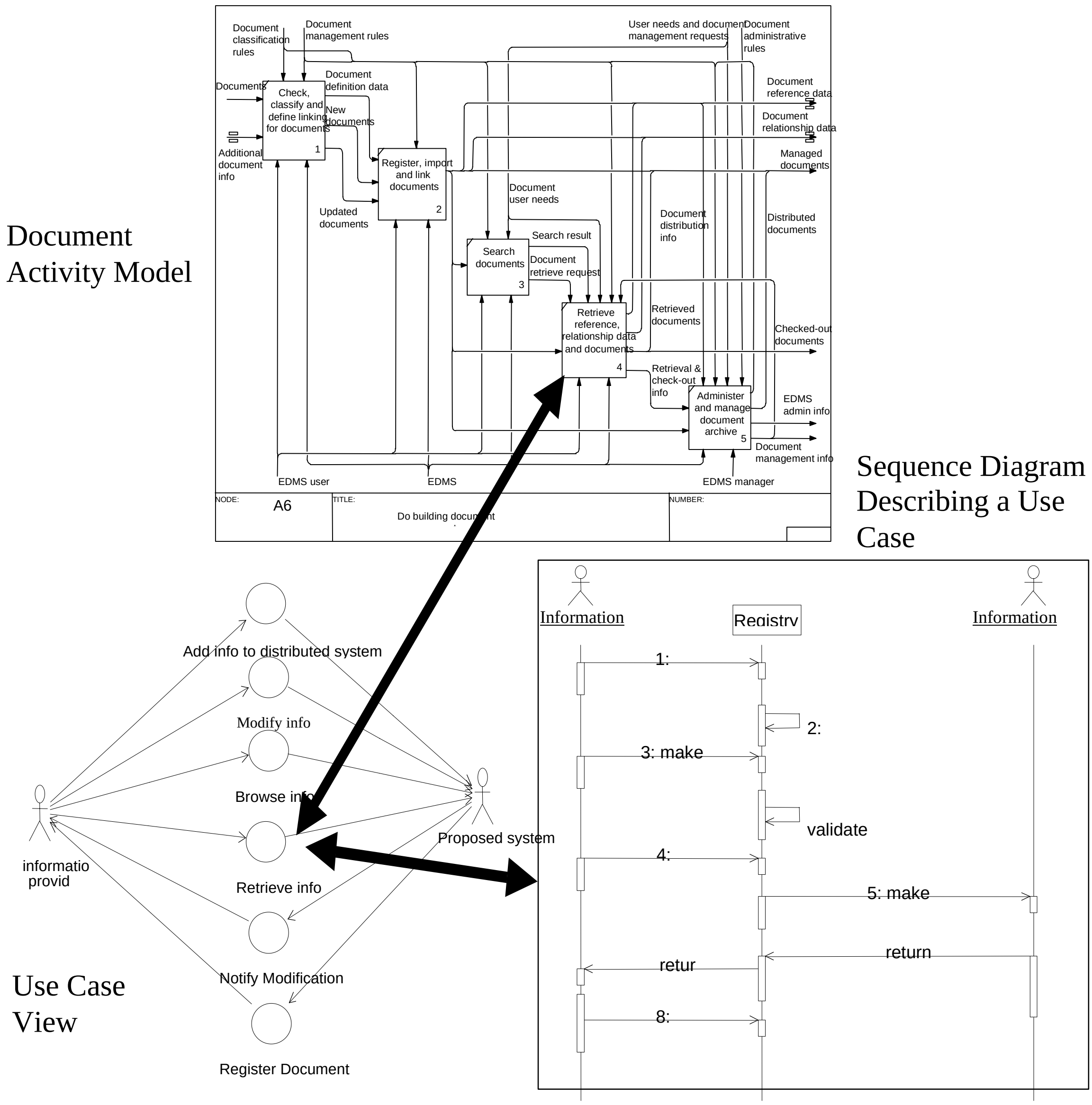

Figure 2: Combination of IDEF0 with UML to capture the OSMOS requirements.

The use case approach from UML bears some similarities with the IDEF0 approach, in the sense that they both aim at providing a basis for the understanding, definition and capture of the requirements of the system to be developed. They proceed, however, differently. UML looks at the different ways of using a system by specifying all the proposed system use cases. Every single use case is detailed via a sequential description of the interactions between the different artifacts involved within it. IDEF0 provides a top-down hierarchical description of a process activity model, along with information / material flows between those activities. The latter is described via Input, Control, Output and Mechanisms between activities. Both approaches are complementary and will be used in conjunction.

Table 1 shows the various methodologies that are currently used in business process redesign. From this table it can be seen that a combination of IDEF0 and UML Use Cases comprehensively covers the purposes to be addressed by the OSMOS approach.

Technique	**Redesign Purpose**						
	Process overview	Financial estimation	Workflow management	Interaction analysis	Business risk analysis	Role modelling	Resource allocation
Process mapping	X		X				
IDEF-0	X		X	X			X
Simulation					X		
Role-activity diagrams			X	X		X	
Activity-based costing		X					
Deployment flowcharting			X				X
UML Use Cases	X			X		X	

Table 1: Techniques in Redesign

3. Proposed Templates

In order to facilitate the description of the Use Cases, templates have been designed and proposed for both Use Case, and software / hardware description. The end-users are expected to provide a sufficient and detailed number of use cases in order to facilitate the capture of the OSMOS requirements.

3.1 Use Case description template (see Annex 1)

A use case is a sequence of actions performed by the system, which normally corresponds to a business transaction and produces a tangible result. The following elements are expected to be provided by the end-users for each identified Use Case:

- ✓ **Use Case**: name and number
- ✓ **Author**: name

- ✓ **Creation or last update Date**
- ✓ **Abstract**: short description of the objectives of the Use Case
- ✓ **Operational Context**: this part explains the specific context in which the Use Case is supposed to be applied (*This Use Case is performed when …*) as well as the potential constraints (at least those known at that step of the formalisation process) like: frequency of application of the Use Case, input/output data (this can be linked to some initialisation of parameters that are internal to the system), possible concurrent operations, availability of data (i.e. data that exist and are available, or not available when the Use Case is fired, or totally unknown, etc.), confidentiality, friendliness of the user interface, etc.
- ✓ **Actors**: identification of all actors (at least one) involved in the Use Case
- ✓ **Use Case Pre-conditions**: they describe the functional prerequisites, such as initialisation conditions, use restrictions, etc.
- ✓ **Description**: it may include the following information (the list is not restrictive):
  - The triggering event
  - The sequence of interactions and information exchanges between the system and the actors
  - The identification of data that are handled, modified, recorded, etc.
  - The possible iterations (repetitions) and the rules of selection (*if … then …*)
  - The events (messages) sent to actors
  - Etc.
- ✓ **Exceptions**: this part describes the anomalies that can occur during the process
- ✓ **Use Case Post-conditions**: they describe the possible constraints put on the system at the end of the Use Case. It should be noted that pre-conditions and post-conditions provide a way to understand (and check) the sequence of Use Cases.

3.2 Template to describe the current software and hardware infrastructure (see Annex 2)

This template proposes a common way to describe software tools that are expected to be integrated into the OSMOS architecture. The description addresses the following issues (the list is not exhaustive), for each identified software tool:

- ✓ **Software Application**
  - Name and functional description of the application

  - Possible extensions, including the extension type (additional code, plug-in, etc.)
  - Interface with other applications (just mention the existence, the description will be done elsewhere)
  - Rough description of the user interface
  - Possibly, description of the architecture: standalone PC application, client/server (with most processing on the client, or on the server), middleware, 3-tier architecture, etc.

- ✓ **Hardware**
  - Required hardware
  - Operating system
  - LAN, WAN, or Internet-based
- ✓ **Communication**: it relates to the communication resources that are available for integration with other applications
  - Existence of an API
  - Share of common database(s)
  - Use of a protocol
- ✓ **Native Data Structures**: the question here is to ascertain whether or not the software application relies on a semantic data model
- ✓ **File Format**: the format of the files used for data input or output
- ✓ **Data Storage Technology**: this issue mainly relates to the localisation of data (distributed database, centralised database, etc.), and the storage technology (relational, object-oriented, etc.)

3.3 Template to describe the interfaces (see Annex 3)

This third template is intended to describe the set of interfaces implemented between the various software applications. The identification of these interfaces should be naturally done on the basis of the previous steps, in particular the Use Cases and the functional description of the software applications currently in use. In a subsequent phase (not included here, see WP2), this description will be complemented by that of the interfaces to be implemented between each application and the OSMOS architecture.

The template contains the following information:

- ✓ **Interface number**: a non ambiguous identification number
- ✓ **Interface title**: a short but self-explicit title (as much as possible)
- ✓ **Description**: it should briefly mention the context in which the interface is implemented, e.g. what is its role, what data are transferred, in which operational context it is implemented (at what time, by which application, etc.)
- ✓ **Interaction**: it addresses how the interface is called up, e.g. by simple request (launching a function), request/answer, batch processing, etc. These kinds of interaction can be characterised by specific attributes: synchronous or asynchronous[1], locking or not[2], etc.
- ✓ **Transferred information**: this section describes the nature and type of the information that is transferred by the interface, as well as the transfer direction. It can also mention if a procedure exits to validate information before putting it in the target application.
- ✓ **Call up frequency**: it describes how the interface is called up, e.g. as many times as required, on request, automatically (on specific events), through notification, etc.
- ✓ **Updating frequency**: updating information can cause inconsistencies and integrity problems in the system. The updating frequency has therefore a significant impact, which implies to also update information exchanges previously made.
- ✓ **Required reactivity**: e.g. real time, a day, a week, etc.

3.4 Current skills (see Annex 4)

Analysis of current skills is part of the work required in WP1 along with the business process analysis. The end-users will be required to provide a detailed list of the IT skills required to operate the business processes. The processes in question are all of those which fall into the three categories relevant to OSMOS, i.e. business process and information management practices, interactions between teams on projects, and common construction applications.

The three templates are open-ended. It is envisaged that each could run to several pages in length. The important point is that *all* relevant processes and business activities are included.

This information is required for three main purposes that are of great benefit to the end-users:

1. skills
2. training needs

[1] A communication is called synchronous when the server reacts instantly, or almost, to the client's request. It is called asynchronous when the processing of the request can be postponed.
[2] A mode is locking when the client must wait for the server's answer before continuing his processes.

3. facilitating change

In order to re-engineer processes it is important to be aware of the current level of skills available in the work place, to ensure that there are enough skills to operate the new processes. This analysis will highlight any training needs such that they can be identified cost effectively after the OSMOS project. Awareness of such requirements will facilitate a smooth change process, not only in terms of recognising training requirements prior to the implementation of the processes, but also in terms of acceptance of those changes.

Further to this the information will also form the basis for the work in WP4. The information required here is IT based. A further survey will follow to cover managerial/organisational aspects.

4. Conclusion

The analysis work in WP1 aims to describe and detail the intra-company business processes and information management practices of the three end-user organisations of the OSMOS project, the type and nature of inter-company interactions taking place on multi-disciplinary construction projects and the set of tools commonly used on projects. The methodology proposed to carry out this analysis is a combination of complimentary approaches including IDEF0 for the higher level processes, and a set of Use Cases to specify the OSMOS system requirements at a lower level. In order to capture fully the requirements of the proposed system in this way, a set of templates have been provided to aid the end-users in detailing their processes.

This analysis, when completed, will allow the consortium to define and agree a Generic Process Model, illustrating the basic processes that take place in a VE.

Annex 1: Use Case Description Template

Use Case : Author : Creation or last update Date :

Abstract:

Operational Context

Actors

Use Case Pre-conditions

Description :

Exceptions

Use Case Post-conditions

Annex 2: Template to describe the current software and hardware infrastructure

Software Applications

Hardware

Communication

Native Data Structures

File Format

Data Storage Technology

Annex 3: Interface description template

Interface number : Title :

Description:

Interaction

Transferred information

Call up frequency

Updating frequency

Required reactivity

Annex 4: Current skills survey templates

Business Process / Information Management Practice	IT skills you have in order to operate

Interaction	IT skills you have in order to operate

Software Application	IT skills you have in order to operate

Appendix 2

Derbi's detailed intra-company business process analysis

This Appendix presents IDEF0 models describing Derbi's business processes in the format described in Chapter 3: OSMOS Requirement Capture Methodology.

Appendix 3

Granlund's detailed intra-company process analysis

This appendix presents IDEF0 models detailing Granlund's process descriptions. The top-level model (A-0: OSMOS VE Process model) describes the data management process (A1: Establish and maintain OSMOS VE) as well as the core business process (A2: Manage BS design and FM).

The business process model (A2: Manage BS design and FM) comprises the current *Granlund design methodology including the usage of computer-based tools and data exchange.*

Appendix 4

JM's detailed intra-company business process analysis

This Appendix presents IDEF0 models describing JM's business processes in the format described in Chapter 3: OSMOS Requirement Capture Methodology.