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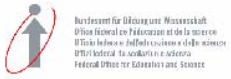
Workshop 4

Towards Interoperability of Enterprise Heterogeneous Enterprise Networks and their Applications : from Industries needs to ATHENA requirements



Workshop 4

Towards Interoperability of Enterprise Heterogeneous Enterprise Networks and their Applications : from Industries needs to ATHENA requirements

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:
Main Topic: Industry requirements for interoperability of enterprise applications and Software
Goal: Share with the audience current results and discuss with them needs and requirements for interoperability

WS committee

- Nicolas Figay (EADS CCR, France)
- Massimo Ippolito (CR-FIAT, Italy)
- Maria Jose Nunez (AIDIMA, Spain)
- Rainer Ruggaber (SAP , Germany)
- Ricardo Goncalves (UNINOVA, Portugal)
- Frank Lillehagen (COMPUTAS, Norway)

The workshop is open to any IT related enterprise. The topics to be address are related to interoperability problems focused in some sectors as automotive,

aeronautics, telecommunications and furniture. The Program Committee will revise all contributions and will select the best ones.

The workshop aims to present and discuss with the audience the current results of ATHENA programme related to industry short and long term needs and requirements regarding interoperability of enterprise software and applications. In particular, the way industrial interoperability requirements are handled within the programme will be presented and specific examples of industry scenarios indicating interoperability needs and solutions will be provided. Nevertheless, the industry scenarios will be used also for testing the solutions provided by the R&D technology providers and for the development of the future scenarios with the needs of the industry in terms of interoperability. Also, under the ATHENA programme, a general model for determining the impact of interoperability on business will be provided by stating the strategic business challenges relating to interoperability.
Organizer Presentation:

INTRACOM was established in 1977 and nowadays constitutes the largest Greek new technologies company with domestic and international activity. INTRACOM engineers advanced innovative products, provides expert professional services and undertakes complex and large-scale integrated technology projects across the four basic economy sectors of: 1) Telecommunications 2) e-Government and Public administration 3) Banking and finance 4) Defence.

AIDIMA, the technological institute for the wood and furniture industry, is a non-profit scientific and educational organisation which is active throughout Europe and particularly in Spain. The main aim of AIDIMA is the transfer of RTD and technological innovation to the Spanish wood and furniture sector to enhance competitiveness in the global market. AIDIMA was created due to an initiative of the private companies in the wood and furniture sector and established in 1984 with the initial support of the Valencian Government, the Spanish Ministry of Industry and the European Union. Today, AIDIMA is the scientific umbrella organisation for almost 650 associated companies throughout Spain. Areas of Expertise: 1)Wood Technology, Wood-Based Composites, Components and other Raw Materials, 2) Furniture and Joinery, 3) Packaging & Transport, 4) Information Technologies, 5) Sectorial Information & Market Analysis 6) Education & Training

Program:

- ATHENA IP Presentation
- Interoperability Requirements Handling and Specific Scenarios (short term view on interoperability requirements) - Validation and Evaluation
- Long term interoperability requirements

duration: 3 hours

Framework for training and education activities in interoperability of ESA

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Abstract. The ATHENA Training Service offers high quality training in interoperability, aiming to generate an extensive impact in the field of interoperability. It allows students to understand the why's and how's of today's common problems at business level, which are directly or indirectly caused by interoperability problems. Having lecturers with international recognised expertise in interoperability, the ATHENA training courses and programmes are designed to meet the specific interests of different target-groups, which vary from academia to industry, from IT to business oriented, from software engineers to senior consultants, and from researchers in interoperability to university teachers. Thus, the curriculum is targeting everybody concerned with interoperabil-ity issues that affect today's business at several industry sectors. Each course has its own target audience, and students can choose from a large variety of courses, which focus different interoperability application areas, the ones that most suite their requirements and needs. A blended learning offering is provided, consisting of classroom, virtual classroom and e-learning training for the interested parties. Basic training is offered in different languages, while specific training is only offered in English. This paper presents the framework for training and education activities in interoperability of ESA, that is in development by ATHENA.

1 Introduction

ATHENA comprises the leading European experts in the field of interoperability, allowing students to be in touch with a respected panel of internationally recognised experts, on interoperability areas.

ATHENA research results are transformed into appropriate training courses, allowing the students that enrol the courses to be in the state-of-the-art, and in a position to apply the gained knowledge in the improvement of existing and problematic solutions.

Beside the advantage as regards contents, the ATHENA training services have high didactical quality of the offered training courses. Expertise in research allied with training in an attractive form provides a strong guarantee of success. In this respect modern e-learning and virtual classroom trainings are an advantage, distinguishing the ATHENA training from its competitors.

2 Benefits for participants

With the help of the trainings offered by the current curriculum, students will be enabled to implement and operate interoperability technology. Moreover, they get insight into the methodology and techniques that are relevant in the field of interoperability. These measures will help enterprises to improve their relation to their business partners, reducing time and monetary efforts.

The training service should be understood as enabling for a reduction of costs and an increase of performance for interoperability. Designed to be inexpensive when compared with costly consulting services, which can be avoided while simultaneously achieving a long-term effect by transferring the required expertise to the relevant employees, getting maximum total value from the investments they've made. Thus the return on investment is achieved by the improved interaction opportunities with all business partners who possess the same expertise

[1] In the context of ATHENA Dynamic Requirements Process, a product is considered as a concrete implementation of a given solution, in particular the tools that can be produced by solution providers.

and ability of performance in interoperability. Such ability will represent a decisive factor in the competition with those that not dispose these capabilities.

3 Structure

The structure of the curriculum for training in Interoperability is depicted in Figure 1.

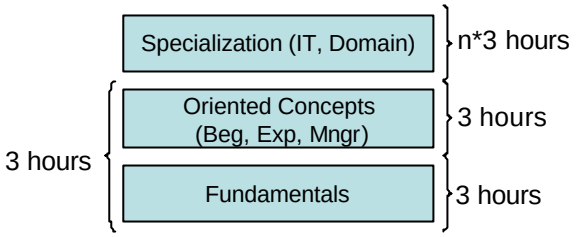


Figure 1 - Structure of the curriculum

It consists of 3 blocks: Fundamentals, Oriented concepts and Specialization.

The block Oriented concepts is divided in 3 focused targets: Beginners, Experts and Managers, whilst the block Specialization is divided in 2: IT and Domain. For particulars about this division, please see section Target Groups.

The Fundamentals block endows the students with the basis and scope on Interoperability. This is a common block for all training programmes, with one unique module of 3 hours, in order to assure a common level of all students in class.

The Oriented concepts block, gives to the students the essential concepts needed to prepare them for a specialization. This block has 3 different orientations, depending of the background of the student, i.e., Beginner, Expert and Manager. In this way, specific matters are focally coursed to better approach the student and put him at the required stage. Such matters include essentially concepts that complement the students' background to enable them to have the same level of knowledge when starting coursing the Specialization. 3 modules of 3 hours are part of this block, where just one it is expected to be coursed to a student.

When it is recognised that students already have the basic knowledge in interoperability, these two blocks can merged, resulting in a compact course of 3 hours.

The Specialization block is a major block of the curriculum. The block is organized in clusters of modules, each one of 3 hours, representing each cluster a category of courses in a specific area of Interoperability.

Depending of the speciality of the programme to be executed under this curriculum, a set of modules, from one or more areas, is selected. Figure 2 depicts this structure of the curriculum. On section 0 is described in detail the list of available courses, and respective areas of classification.

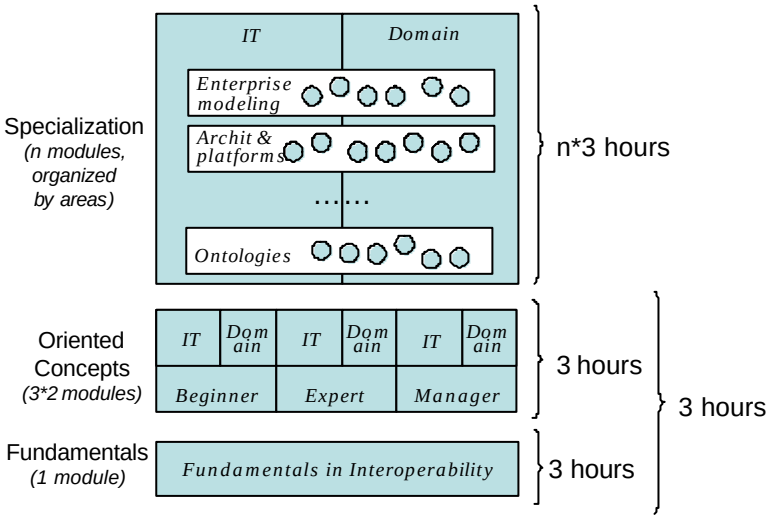


Figure 2 - Detailed curriculum structure

4 Courses

Courses are the components for training programmes. The available courses are organized in 5 main categories, representing clusters of specialized modules in core interoperability areas. They are:

- Enterprise Modelling (EM)
- Architectures & Platforms (AP)
- Product data exchange (PDE)
- Ontologies (ONT)
- Concepts of Interoperability (CI)

5 The target groups

This is a large model with several relationships, and for this reason the relationships between objects are hidden, Figure 3. A possible query is to see what are the characteristics associated with a particular target group. Figure 4 shows a view of the model where is possible to see all the characteristics associated with the Academic Teacher of Computer Science target-group (the relationships are also hidden, being shown only three). Another example of a view is all the target-groups interested in Decision Making Support, Figure 5 (relationships hidden).

Table - Target groups (Beginners)

<table>
<tr><td colspan="2">Target Groups</td><td colspan="2">IT knowledge</td><td colspan="2">Domain Knowledge</td></tr>
<tr><td colspan="2">Focus of Interest</td><td>Industrial Area</td><td>Academic Area</td><td>Industrial Area</td><td>Academic Area</td></tr>
<tr><td rowspan="4">Beginners</td><td>Profile</td><td>Software engineers / developers; Junior consultants; Junior IT vendors.</td><td>Students of computer science (Phd, Msc).</td><td>Junior consultants; Engineers; Developers; Vendors.</td><td>Students of business administration; MBA; Students of organizational engineering (industrial).</td></tr>
<tr><td>Background</td><td colspan="2">General IT knowledge</td><td colspan="2">General domain knowledge</td></tr>
<tr><td rowspan="2">Expectations</td><td colspan="2">Becoming interoperability IT specialist; Gaining deeper knowledge of interoperability.</td><td rowspan="2">Gaining expertise for their job</td><td rowspan="2">Complete their knowledge concerning interoperability</td></tr>
<tr><td>Personal knowledge and skill; Personal promotion.</td><td>Better understanding of job opportunities; Thesis in interoperability fields.</td></tr>
</table>

Table of target-groups (Experts)

Table - Target groups (Experts)

Target Groups		IT knowledge		Domain Knowledge	
Focus of Interest		Industrial Area	Academic Area	Industrial Area	Academic Area
Experts	**Profile**	Software specialists / architects; Senior IT vendors; Senior consultants; Project managers; Technical course authors / trainers.	Researchers in computer science; Academic teachers of computer science.	Domain experts; Senior consultants; Domain course authors / trainers.	Researchers in business administration; Academic teachers of business administration.
	Background	Detailed IT knowledge of their infrastructure. Knowledge of other IT training courses (course authors / trainers).	Experts in their interoperability field; Detailed knowledge of specific technologies.	Detailed domain knowledge with respect to their focus area; Basic IT knowledge; Knowledge of other domain training courses (course authors / trainers).	Detailed knowledge of applications, processes and industries
	Expectations	Gaining overview of technical solutions; Information relevant for practical applications; Improvements of the IT infrastructure; Create elegant working technical solutions; Learn how to integrate new interoperability technologies; Improve capacity to monitor and manage interoperability IT infrastructure; Knowledge about standards; Deeper understanding of tools; Gaining knowledge for IT training courses on interoperability (course authors / trainers).	Keeping up-to-date on developments; New approaches and methodologies for teaching; Extend knowledge in related areas.	Interoperability opportunities for their domain; Interoperability market requirements and standards; Domain problems well supported by technology; Interoperability solutions & their application at domain/business level; Gaining knowledge for domain training courses on interoperability (course authors / trainers)	Keeping up-to-date on the opportunities of interoperability; New approaches and methodologies for teaching.

Table of target-groups (Managers)

Table - Target groups (Managers)

Target Groups		IT knowledge		Domain Knowledge	
Focus of Interest		Industrial Area	Academic Area	Industrial Area	Academic Area
Managers	**Profile**	IT managers; IT training content administrators.	Research managers of IT programs; Professors of computer science.	Business managers; Business domain experts; Domain training content administrators.	Research managers of business administration; Directors of non-technical disciplines.
	Background	Knowledge of IT infrastructure; Overall business background; Basic business administration knowledge; Interest in future technologies; Overview of existing IT training courses on interoperability (content administrators).	Expertise in their field of interest; Current methodology; Overview on future technologies; Infrastructure to conduct research in their domain of expertise.	Detailed business knowledge; Knowledge of business processes (e.g. BPM, BPR, EM); Understanding business governance; Basic IT knowledge; Knowledge about business ontologies; Enterprise integration approaches from management point of view (e.g. change management for a merging, reorganisation, branching); Knowledge on Virtual, integrated, networked organisations; Overview of existing domain training courses on interoperability (content administrators).	Expertise in their domain

Target Groups		IT knowledge		Domain Knowledge	
Focus of Interest		Industrial Area	Academic Area	Industrial Area	Academic Area
		Gaining basis for decision making with respect to interoperability initiatives Overview of technological trends and Decision making support		Informative basis for decision making; Overview of business trends.	
Managers	**Expectations**	Support for planning their IT strategy; Information about cost reduction potentialities of interoperability IT infrastructure; Learn to utilize current technologies and integrate new technologies in an organization for maximum impact and efficiency; Understand how to integrate IT infrastructure within enterprise strategy & models (from an Interoperability perspective); Cost reduction to monitor actual management of interoperability IT infrastructure; New technical solutions to business problems that are practical to implement; Identification of additionally required courses (content administrators).	Ideas for research programs; Impact of interoperability trends on their field of research; Creation of new academic curriculum.	Support business strategy; Improve company management; Optimization of business processes; Improve flexibility with respect to market needs; Understand technologies, which can overcome business challenges, maximize results, and provide return on investment; Reduce infrastructure costs; Create competitive organization and products; Identification of new business opportunities; Plan the process to move from the current way of making business to become a networked organization; Awareness of other commonly used business processes. Authority interest in adapting new technologies and methods; Identification of additionally required courses (content administrators).	New aspects of business administration; Identification of research issues in the area of interoperability.

Target-groups model

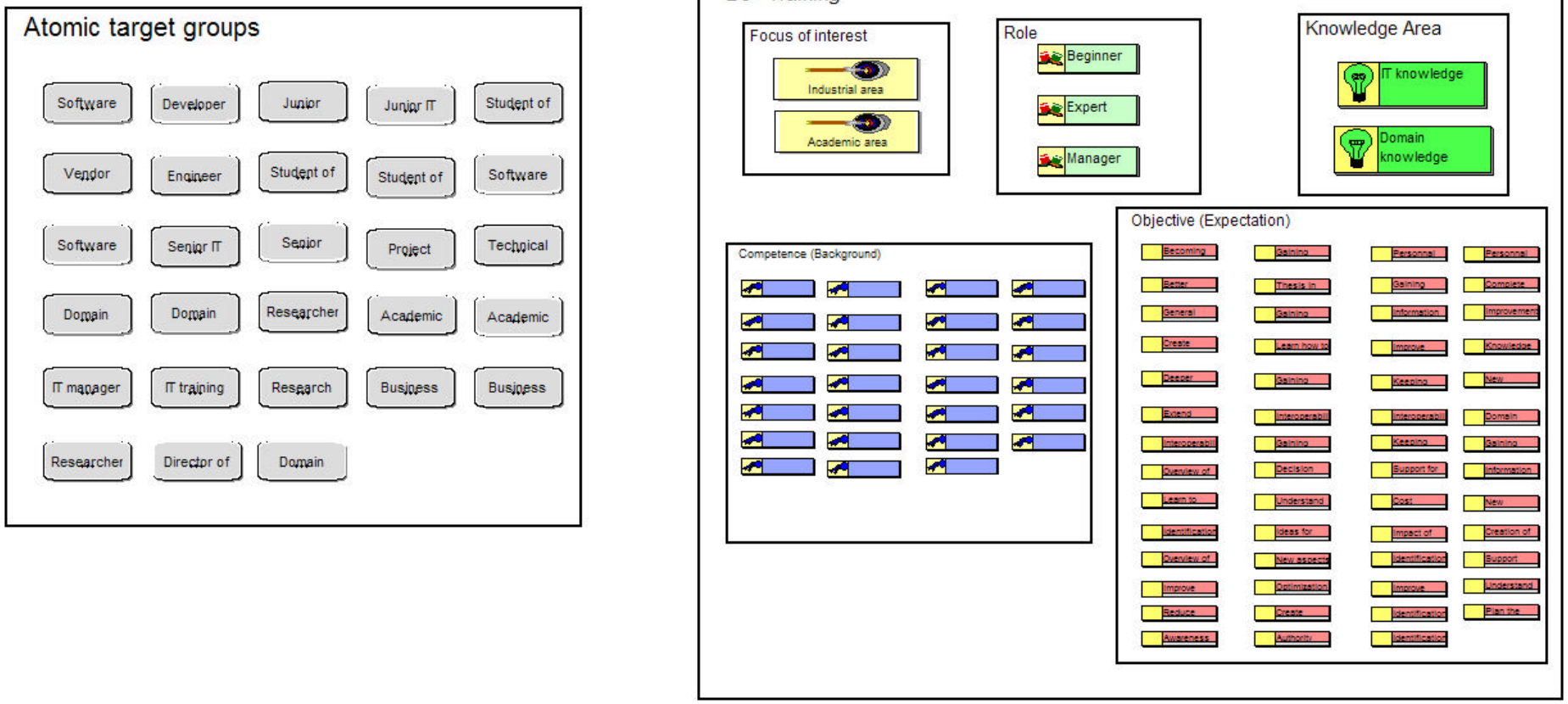


Figure 3 – Target-groups model

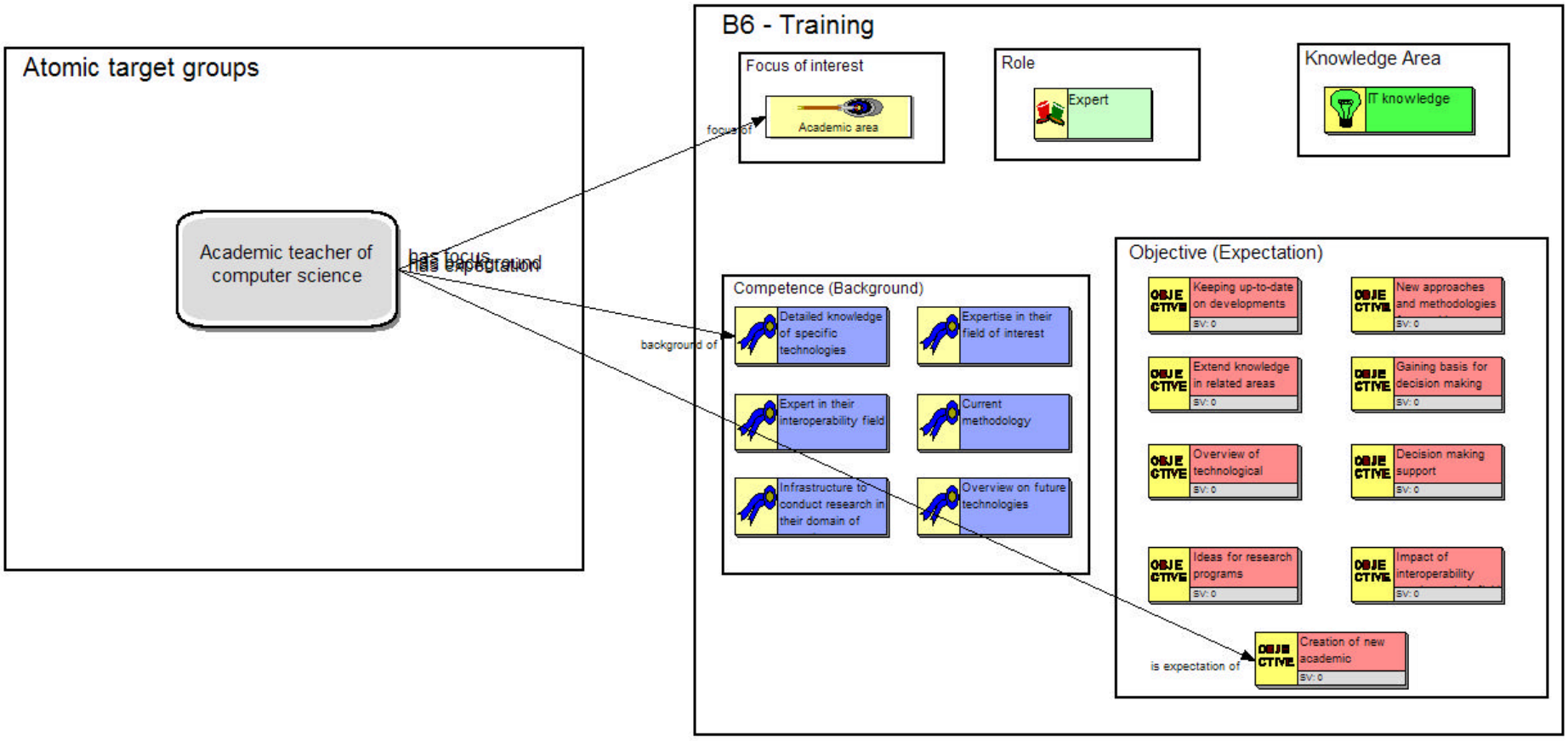
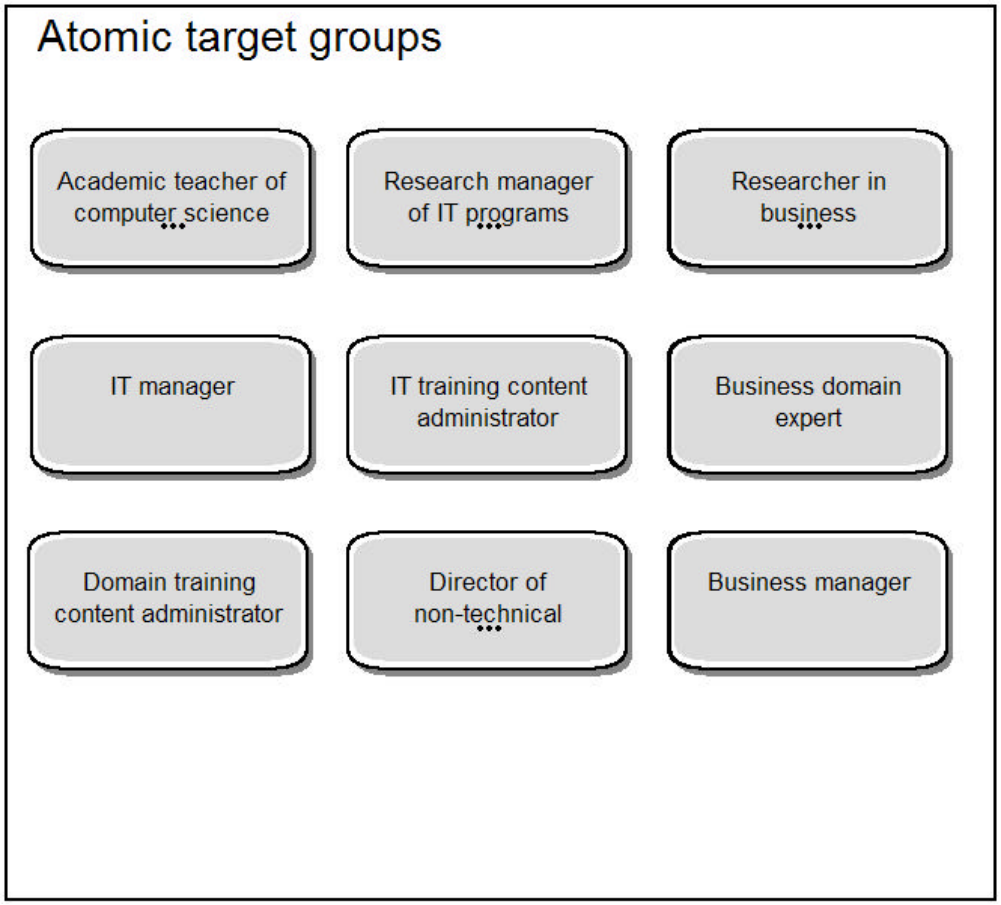


Figure 4 - Academic Teacher of Computer Science



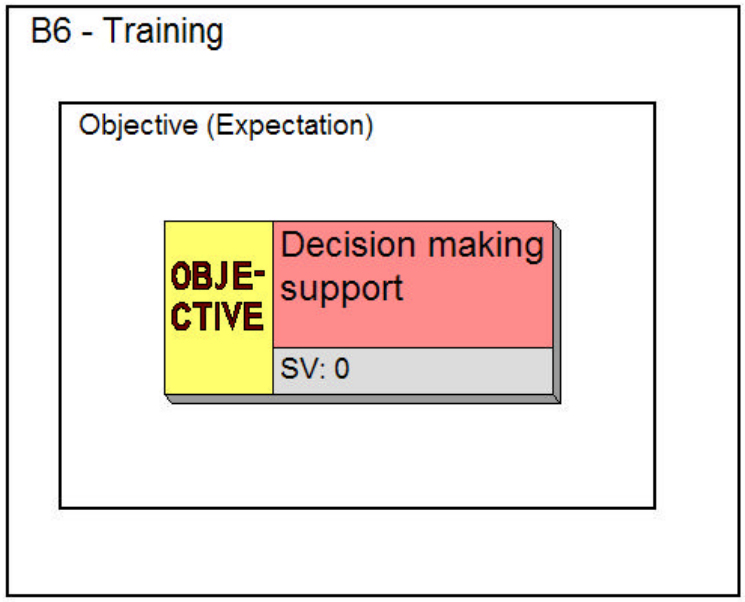


Figure 5 - Objective of Decision Making Support

6 Training service plan

A detailed training service plan is being scheduled. The training service plan will focus on industry and research. The first will conduct training on industry sectors (automotive, furniture, telecom, aerospatial, B&C and software development), being the courses carried out at correspondent partner sites. On the research field, ATHENA aims to give courses at relevant international conferences, and events on the field of interoperability. Universities will play an important role, and courses should be rolled out to MsC at universities across Europe in the term 2006-2007.

Towards Interoperability of Enterprise Heterogeneous Enterprise Networks and their Applications - Requirements Handling and Validation activities

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Abstract. This paper presents the current results of ATHENA-IP programme. More specifically, the paper focuses on the programme's activities related to interoperability requirements handling and validation activities. The first part of the paper describes the ATHENA Dynamic Requirements Process that was defined to deal with requirements management within the different sub-projects, presents the Industrial sectors represented in ATHENA and their areas of interest as these are reflected in the industrial scenarios they are focusing on. The second part of the paper summarizes the current piloting activities and presents the validations methodologies that have been defined to support the pilots.

1 Introduction

ATHENA (Advanced Technologies for Interoperability of Heterogeneous Enterprise Networks and their Applications) integrated project (IP) aims to be a comprehensive and systematic European research initiative in IT to remove barriers to interoperability, to transfer and apply the research result in industrial sectors, and to foster a new networked business culture.

This paper presents the current results of ATHENA-IP programme related to industry short-term needs and requirements regarding interoperability of enterprise software

and application. In particular, the way industrial interoperability requirements are handled within the programme is presented and the scenarios used for extracting specific interoperability requirements are briefly described. The requirements handing in ATHENA is carried out within the context of B4 sub-project named Dynamic Requirements Definition.

The scenarios and the specific requirements form the basis for developing test cases and validation scenarios through which the evaluation and testing of the solutions provided by the R&D technology providers will be performed. Validation activities are performed under ATHENA B5 sub-project named *Piloting including Technology Testing Coordination and Pilot Infrastructure*. The methodology and the first test cases to be used for the validation are also presented in section 3.

2 Interoperability Requirements Handling

Interoperability of enterprise applications and software in a networked organization is a complex topic for which gathering; elicitation, analysis and management of requirements are difficult activities. As it is illustrated in Figure 1, we have to deal with a complex system of independent subsystems, with different lifecycles, and with numerous stakeholders with conflicting interests. Classical requirements engineering approaches used in IT projects are not adopted to deal with these issues.

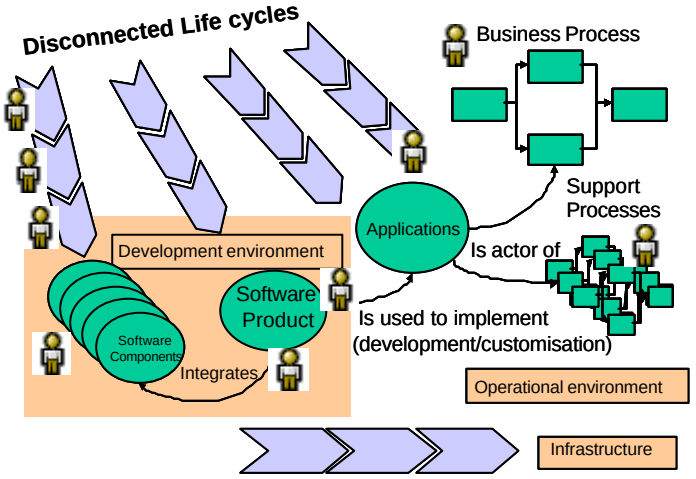

Fig. 1. Stakeholders, software ad applications in an interoperability scenario

Another important factor that we had to take into consideration was that the requirements handling approach of ATHENA will be used actually by a programme of projects and that a community, the Enterprise Interoperability Center (EIC), will finally adopt it.

Therefore, we took into account classical requirement engineering methods, and moved one step forward to address the purposes of the programme.

Towards this direction, our approach was to define a method and an associated process for enhanced requirement engineering in order to provide a coherent and common way for the different projects to perform their activities concurrently and to integrate as soon as possible evolution in terms of solutions or needs coming from the market. This is the reason why we are talking about dynamic requirements definition process.

2.1 ATHENA Dynamic Requirements process

This section presents the requirements process that was formed and adapted by ATHENA. The process is called the ATHENA Dynamic Requirements process. Figure 2 provides and overview of the process.

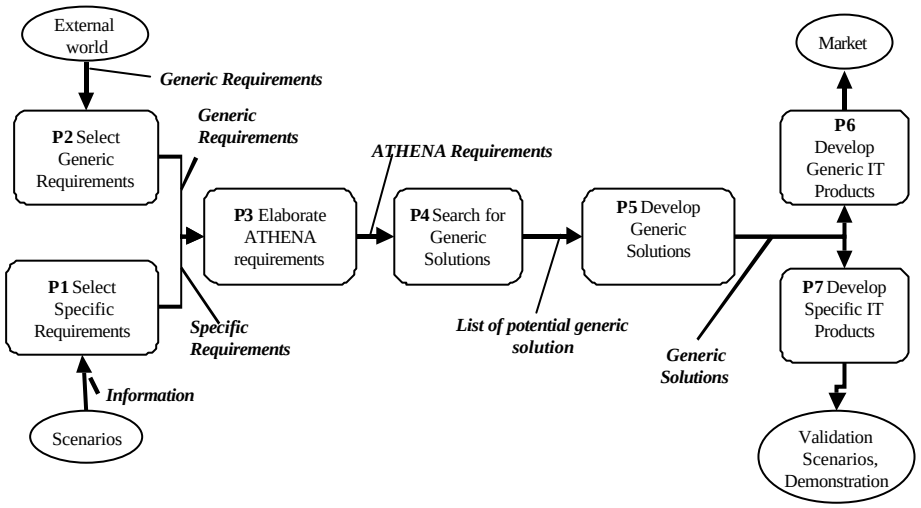

Fig. 2. ATHENA Dynamic Requirements process

We determine two origins for the requirements. The first one is the set of scenarios proposed by the industrial users in the ATHENA Programme. From these scenarios, an initial set of requirements is determined: we call these requirements **Specific Requirements**.

On the other hand, a lot of requirements had already been proposed by the literature, other projects, in particular the Unified Enterprise Modelling Language (UEML) Project (IST – 2001 - 34229) and IDEAS Thematic Network (IST-2001-37368). We call these requirements **Generic Requirements**.

In both cases, the objective of the first activities (P1 and P2) is to determine which requirements belong to the ATHENA Programme domain. So from P1 and P2 we get the Specific and Generic Requirements for ATHENA. The third activity (P3) is to analyse and select this set of ATHENA Requirements in order to:

? Determine the requirements according to interoperability issues,

? Collect the needed information about requirements including a classification according to industrial needs (inside and outside ATHENA), priority in terms of market, etc.
? Provide consistent requirements definition.

The rest of the phases are outside the scope of B4 subproject, but they are very important in order to have the complete process. A brief description of is following provided.

In Phase 4, the list of Potential Generic solutions is determined, based on the selected Athena Requirements.

Phase 5 is related to the development of the adapted Generic Solutions, which follows after an agreement inside the project.

During Phase P6, generic Information Technologies (IT) Products[1] will be proposed by the Information Technologies (IT) suppliers.

Finally, in Phase P7, Specific Information Technologies (IT) products will be proposed to the ATHENA Industrial Users, in order to answer to the initial requirements deduced from their scenarios. Some specifics validation scenarios, in accordance of realised Test plans, will be the outputs of P7.

If we consider ATHENA Dynamic Requirements process in the light of the classical requirements engineering approach, then we could illustrate how ATHENA Dynamic Requirements Process addresses the same issues that are addressed in classical requirements engineering. The classical requirements engineering process consists of the following sub-processes:

? Requirements determination and gathering.
? Requirements elicitation, analysis and modeling.
? Requirements negotiation.
? Requirements validation.

Requirements Determination and Gathering

Requirements are gathered from research activities and the industry. These requirements are considered in the context of the ATHENA project. Research activities provide a set of generic requirements while industrial users provide a set of specific requirements. These requirements can be modeled for the purpose of managing them and viewing information related to them in a structured manner.

Requirements Elicitation, Analysis and Modeling

The requirements elicitation sub-process provides an initial set of requirements for ATHENA, which can then be generalized and analyzed according to the objectives of the project and interoperability issues. The requirements can then be categorized according a specific classification and modeled for the purpose of managing the requirements and the information related to them.

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[1] In the context of ATHENA Dynamic Requirements Process, a product is considered as a concrete implementation of a given solution, in particular the tools that can be produced by solution providers.

Requirements Negotiation
Requirements negotiation takes place between the developers and stakeholders and among the stakeholders to select a set of requirements that is mutually acceptable for all parties. For example, to agree upon the requirements that will be fulfilled by a particular solution.

The requirements negotiation may occur at different places, within different subprocesses of the Dynamic Requirements Definition Process, e.g. P5 and P7. This is because in P5, the negotiation will be about developing generic solution addressing given ATHENA requirements, and about giving priorities related to this development. In P7, the negotiation will be about developing a pilot or not, that will take into account some other constraints. The negotiating parties and stakeholders in P5 differ from the ones in P7.

Requirements validation
Requirements validation is conducted to examine the set of requirements to find out potential problems with these requirements.

2.2 Scenarios in ATHENA

As it has already been mentioned, specific interoperability requirements are extracted through the analysis of real life scenarios. The initial set of scenarios in ATHENA has been formed based on the needs and interests of the industrial users in the programme. The four industrial sectors and their representatives currently inside the programme are presented in table 1.

Table 1. Industrial Sectors and their representative in ATHENA

Sector	Company
Aeronautic and Aerospace	**EADS CCR** European Aeronautic Defence and Space Company (EADS) is Europe's premier aerospace and defense company and No. 3 worldwide. EADS comprises the activities of the founding partners Aerospatiale Matra S.A. (France), Construcciones Aeronáuticas S.A. (Spain) and DaimlerChrysler Aerospace AG (Germany). EADS CCR is the French part of EADS Corporate Research Centers. EADS CCR has a permanent staff of 250 people, 60% of which are senior scientists.
Automotive	**Fiat CR** Fiat Research Centre (CRF) is an industrial organization having the mission to promote, develop and transfer innovation providing competitiveness to its partners: Fiat Sectors, external SMEs, national research agencies and the European Commission. CRF fulfils its task by focusing on: development of innovative products, implementation of innovative processes

	(manufacturing and organization), development of new methodologies, and training of human resources.
Furniture	**AIDIMA** AIDIMA is a research and development association for the wood and furniture industries. It is a private, not-for-profit Spanish industrial association made up of more than 650 furniture manufacturers, many of which are small and medium size enterprises (SMEs). Founded in 1984, it has more than 70 employees and several offices across Spain.
Telecommunication	**INTRACOM S.A.** ???RACOM was established in 1977. Nowadays, it constitutes the largest Greek new technologies company with domestic and international activity. It engineers products, provides services and undertakes complex and integrated large-scale technology projects across the four basic economy sectors of: Telecommunications, Government, Banking and Finance, Defense systems .

The industrial scenarios initially defined cover the following four areas.

Product Data Management in a Virtual Networked Enterprise

The concrete case concerns sharing and exchange of technical information in the aeronautic sector for the change management process and for different types of supply chain relationship. Important factors that are specific to the Aeronautic and Defense sector:

- The long lifecycle of an aircraft (around 50 years long). This means that information about it should be useable during the whole lifecycle, which is longer than the lifecycle of an application, software product or even an organisation.
- The complexity of the product, due to high level of reliability required, and the number of disciplines involved.
- Change management is very important; a product is defined as a set of ordered modifications.

This scenario highlights a family of cases mainly to deal with the first factor.

Collaborative Product Development

This scenario focuses on the Automotive sector and on the Product Development Process portion that prescribes the suppliers involvement on the objectives definition and on the product planning: Collaborative Product Development (CPD). CPD can be depicted as a three phases process that starts with the **Target Setting** and the nearly contemporary suppliers choice process or **Sourcing**. A third phase, once defined the suppliers' panel, consists in the real **Product Design**. Along the whole PDP process, the interaction between OEM and suppliers consists in a heavy exchange of information, sometimes conveyed through the net, and sometimes directly transferred face to face during meetings. Also if in most cases data are managed by suitable Enterprise

Information System, human action is needed in order to carry out these data from a system to another.

e-Procurement

The objective of the e-Procurement scenario is to facilitate e-Business services interoperability and implementation of integration mechanisms by analysing the current e-Business implementation level in furniture sector and promoting multi-sector international agreements.

Product suppliers sell goods over the Internet through sell-side e-Commerce applications. Buying companies purchase goods over the Internet through buy-side e-Procurement applications. The scenario focuses on an e-Procurement application, through which members of a buying company purchase goods from multiple suppliers.

Product Portfolio Management

The focus of this scenario is on the management of the portfolio of new product development projects (NPD Projects), including also projects related to the development of new versions of already released products. The Product Portfolio Management is of significant importance especially to large enterprise with many business units and complex products.

The efficient performance of the product portfolio process requires federated information coming from marketing, project execution, as well as from the product life cycle management. It is also a knowledge intensive process, as it presupposes a very good and holistic view of the enterprise: strategy and objectives, skills and competences, as well as experience coming from previous projects. It requires therefore, many different aspects of interoperability to be covered: Business aspects, Knowledge Aspect and ICT aspects. The Product Portfolio Management scenario studied in ATHENA focuses on intra-enterprise level.

Although the above mentioned scenarios are identified and developed by the industrial users, their analysis, extraction of requirements and identification of interoperability solutions is performed through the collaborative work of multi skilled teams including industrial users, methodologists and solution providers. This collaborative work aims to close the gap between research and industry by facilitating users' deeper understanding of research trends, as well as researchers' deeper understanding of industrial needs. It will lead to the development of "realistic" ATHENA global to-be scenarios from which interoperability requirements will be derived and that will form the basis for the evaluation and piloting activities.

3 Pilot Activities and Validation Methodology

The validation tasks inside the ATHENA-IP Programme are carried out under the B5 sub-project named *Piloting including Technology Testing Coordination and Pilot*

Infrastructure. Due to this sub-project, several pilots will be developed to test the solutions provided by ATHENA against the needs of the Industry.

3.1 ATHENA Pilot Cases

The pilots will cover the Aerospace, Automotive, Telecom and Furniture Industries. The piloting activities include the identification and implementation of test cases, test scenarios and test procedures in a real context of industrial users. The test cases and test scenarios are defined taking into consideration the to-be scenarios developed during phase P1 of the ATHENA Dynamic Requirements process. Currently, the following use cases have been defined.

Product Data Management in a Virtual Networked Enterprise

The case is based on establishment of collaboration between two organizations, that use different specific change and configuration management processes, and nevertheless need to have to interconnect their process, in a way that allow interoperability between the heterogeneous Product Data Management Applications and software products. The federation of the processes, applications and software is based on the usage of consensual business (CMII, Manufacturing STEP application protocols) and technical standards at the level of the considered network. Integration of Product models is based on usage of neutral information model related to several disciplines : AP233 for System Engineering, AP239-PLCS for customer support, AP214 for geometry, AP209 for calculation…

Collaborative Product Development Case

The essential test case is centered around the lifecycle of a Request for Quotation (RfQ) document and focuses on the management of process-critical events during the processing of the RfQ and allocated discussion and – if necessary – modification of the technical specification attached to the RfQ.

The core process regarding this case is the parallel process (respect to Target Setting, Sourcing and Design) of "Testing" (Virtual and physical Testing), involving FIAT (OEM) and Suppliers (1st and 2nd Tier). The problem can be represented in this way:

- Inside the CPD there are different applications that manage vehicle testing information in different ways
- The data are stored in different databases using different formats
- Application integration is accomplished through the definition/management of point to point translations that are computationally difficult and expensive

The test case is an integral part of collaborative product development and it is located in the early phase of the CPD, during which an OEM and its 1st and 2nd tier sup-

pliers collaborate in order to verify (and where necessary to amend) a request for quotation (RfQ).

In the automotive sector, major portions of RfQ related input specifications are driven/owned by the OEM. A major problem and obstacle to interoperability between an OEM and its 1st and 2nd tier suppliers are modifications made to the specifications after publishing them together with the RfQ.

There are different reasons for these modifications:

- Availability of new business-level information that change business parameters and may affect the technical specifications
- Inconsistencies and technical problems observed as the RfQ is discussed between the OEM and its suppliers may force changes in the specification
- In some cases, the availability of new technology may lead to changes being made
- Sometimes, business relationships change during the process, and the specification needs to be adopted to the capabilities of new suppliers

e-Procurement Case.

The Test Case for the e-Procurement Scenario is based on a major Spanish office furniture manufacturer. Currently they are looking at implementing new technologies to assist its interactions with both customers and suppliers. The scenario is divided in two parts. In each case, apart from the manufacturer there is another company implied: either a Supplier either a Retailer.

The Supplier side of the e-Proc scenario deals with the raw material procurement and the Client side deals with Quotations, Orders and Products delivery.

The points to be solved due to the case are the following:

- Repetitive manual process for regular bulk orders
- Confusion resulting from poor product descriptions
- Missing information
- Lag. Time from product order to delivery could be shorter
- Time spent rating supplier

Product Portfolio Management Case.

The PPM case investigates into the use of Model Generated Workplaces to support simultaneous project, resource and results management, performance measurement through work management views, and the provision of shared project and work monitoring views.

The overall objective is to support collaborative work by providing the actors in the enterprise with the tools, information and communication support they need to efficiently perform their work. This could be spitted down into the following expectations:

- Support faster initiation and assessment of collaboration
- Support integration of the various associated enterprise processes, information and roles / people through a single point of entry
- Provide the different actors with an integrated view of the project, products or development initiatives depending on their roles

? Provide the actors with up to date information related to sales, products, project plans and progress status, available and consumed resources
? Improve the communication between the different participants and the coordination work
? Facilitate more justified decisions.

The above scenarios have in common the Business Process Interoperability that plays a crucial role in achieving business integration. In this sense, the interoperability will force the enterprises to slight vary their Business Process to achieve a better performance of their processes that are directly "in touch" with the different stakeholders involved in their processes. Although these stakeholders usually are external to the enterprise that intends to improve its processes, some of them could be integrated in the discipline of the enterprise itself.

In this way, the e-Proc and the SCM scenarios include other business like Providers and Clients of the main Industrial Enterprises to cover the maximum issues. On the other hand, the CPD and the PPM scenarios work over the intradepartmental structure of the selected enterprise.

3.2 Validation Methodology

A set of different methodologies combining methods, procedures and evaluation criteria is proposed for evaluation preliminary, intermediate and final solutions. With these methodologies we intend to satisfy the basic characteristics of a method (clearness, completeness, coherence, impartiality, replicability) and to look at two complementary aspects: the Technical and Business aspects. Both aspects are relevant from an industrial perspective and will constitute the basis for a complete validation activity supported by two distinct methodologies.

3.2.1.Technical Validation

The methodology used for technical validation will draw from the ISO/IEC 9126 methodology "Information technology - Software Product Evaluation - Quality characteristics and guidelines for their use".

The objective of this standard is to provide a framework for the evaluation of software quality. ISO/IEC 9126 does not provide requirements for software, but it defines a quality model that is applicable to every kind of software. It defines six product quality characteristics and provides a suggestion of quality sub-characteristics (Figure 3).

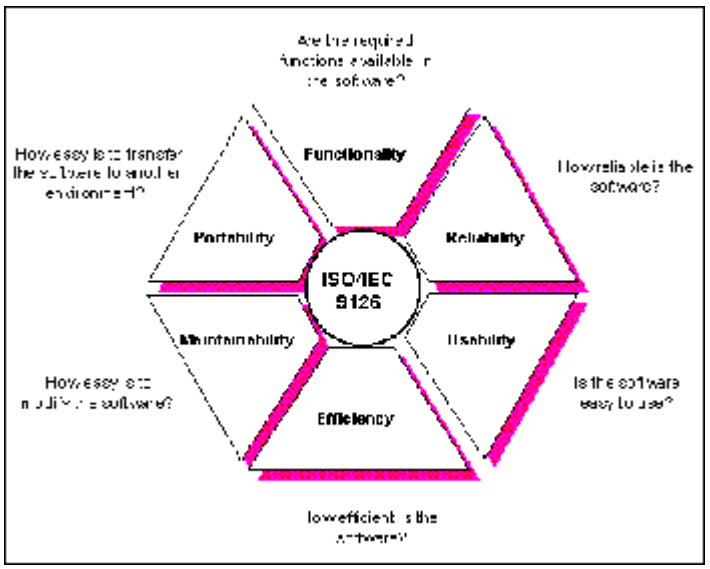

Fig. 3. ISO 9126 Quality Model

In ATHENA such sub-characteristics should be interpreted with respect to the identified reference architecture and Athena Interoperability Framework (multi cultural, multi-lingual, multi-standard) and not just in the specific pilot, in particular, we'd like to take into account the assessment of solutions in terms of architecture, knowledge, business modeling, and ontology.

The criterion used to evaluate the solution is based on the use of qualitative metrics, in order to facilitate the validation. The characteristics will constitute the base on which the testing scenario for the technical validation will be executed and are related to five different levels: Business, Knowledge, Application, Data and Quality.

3.1.2 Business Validation

The business validation methodology will be based on a business perspective and its main goal is to attempt to prove that interoperability has been reached and to identify and evaluate the real benefits deriving from the introduction of a solution in the enterprise.

Whereas it is relatively easy to identify the costs and evaluate the investment on IT, this is not the case with the identification and evaluation of benefits achieved by an organization deriving from the introduction of a new solution able to cover and solve interoperability issues.

For this reason a Business methodology should be tailored to the specific situation in order to verify and assess the impact of an interoperability solution on the involved processes as described by industrial users and if necessary to extend the analysis to related processes.

The suggested methods to evaluate the interoperability from a business perspective and covering several aspects at different levels are:

? Method 1: Solution oriented (identification of real applicability areas)
? Method 2: Process performance oriented (monitoring and evaluation on process performance indicators)

4 Future Work

Future work of ATHENA requirements handling and validation activities include the analysis of the already defined scenarios to extract specific requirements, as well as to identify commonalties and specific issues related to them. Actual validation will commence with simple interoperability test scenarios to test and evaluate preliminary solutions. Finally, as ATHENA enters its second year, additional scenarios will be identified and developed to enter a second iteration of the various activities. It is expected that the defined methodologies for requirement handling and validation will be adapted to reflect the experience gained through their practical application during this first iteration.

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ATHENA – Advanced Technologies for Interoperability of Heterogeneous enterprise networks and their applications

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Abstract.. Organisations are engaging in more and more sophisticated business networks to improve collaboration. These business networks can range from more static relationships like Supply Chains to very dynamic networks like virtual organisations. A prerequisite to enable business networks is the interoperability of the participants systems and applications. ATHENA is an Integrated Project funded by the European Commission under Framework Programme 6 that addresses Interoperability of Enterprise Systems and Applications proposing a holistic approach. ATHENA will provide technical results like reference architectures, methodologies and infrastructures complemented by business results that provide ROI calculations and impact predictions for new technologies. This paper provides insights into ATHENA and how proposed approaches and expected results support business networks.

1 Introduction

One of the trends in the global market is the increasing collaboration among enterprises during the entire product life cycle. This trend requires, that enterprise systems and applications need to be interoperable in order to achieve seamless business interaction across organisational boundaries, and realise networked organisations.

The European Commission considers the development of interoperability of enterprise applications and software as a strategic issue for European companies to strengthen their cooperation and gain competitiveness in the global market. In the context of the EU Framework Program 6 (FP 6) the integrated project ATHENA (Advanced Technologies for Interoperability of Heterogeneous Enterprise Networks and

their Applications) has been funded [1]. It consists of a set of projects and is to lead to prototypes, technical specifications, guidelines and best practices that form a common European repository of knowledge.

ATHENA takes a holistic approach to solving the Interoperability problem taking a technical as well as a business viewpoint into account. Previous activities in that space led to fragmented solutions addressing only part of the problem. From a standards viewpoint in the B2B space there is rather a proliferation than a lack of standards.

ATHENA itself is driven by industry scenarios and requirements. Industrial users in the consortium provide examples from aeronautics, automotive, telecommunications and the SME space. The approach of ATHENA is to go from the specific scenarios provided industrial users to generic requirements applicable to a whole industry. ATHENA looks at the scenarios provided by industrial users in detail and then tries to abstract to industry scenarios common for an industry by identifying commonalities and differences. Currently users from the automotive, aerospace, telecommunication equipment and furniture industry are participating in ATHENA.
The main section of this document gives an introduction into ATHENA and discusses the research activities and the expected outcomes in detail.

2 ATHENA Integrated Project

The ATHENA IP (Integrated Project) [2] aims to enable interoperability by providing reference architectures, methods and infrastructure components. In ATHENA Research & Development will be executed in synergy and collaboration with Community Building: research will be guided by business requirements defined by a broad range of industrial sectors and integrated into Piloting and Technology Testing as well as Training. ATHENA consists of **three action lines** in which the activities will take place [3]. In Action Line A, the research and development activities will be carried out. Action Line B will take care of the community building whereas Action Line C will host all management activities [2]. Relations between the three action lines are shown figure 1.

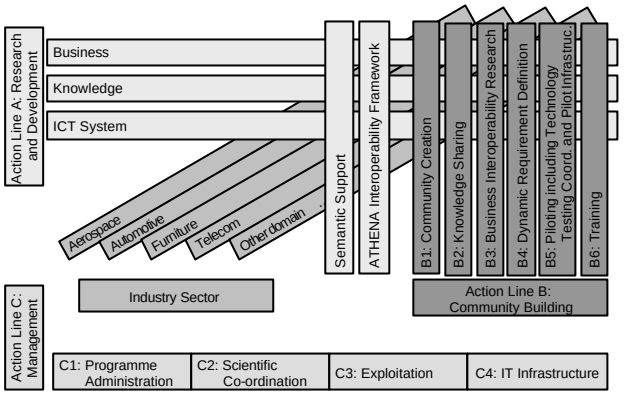

Fig.1 Interaction of ATHENA Action Lines

2.1 Approach

Scenarios play an important role in ATHENA as **sources of requirements** and for the **validation of results**. Scenarios represent the industrial sector-specific implementation of a process and capture industry-specific requirements of a given process. Industry-independent characteristics are described on the process level and are abstracted from the industry-specific scenarios. Scenarios used for validation of results need to be extended with business issues, software and infrastructure, and operational applications used in enterprises. Amongst other criteria, they will be selected based on their general relevance to current and future business paradigms, their general (i.e. industry-independent), industry specific and company-specific characteristics, and their coverage of the anticipated ATHENA approach, methods, and tools. These criteria apply to scenarios provided by partners before the start of ATHENA and to future scenarios.

For each selected business scenario, the partners will provide **detailed descriptions**. These descriptions will be analysed and compared in order to identify commonalities and differences. The description will be based on a common methodology to capture user requirements.

One of the initial tasks (Dynamic Requirements Definition) in Action line B is to provide this methodology to users in order to be able to systematically capture user requirements.

The selection of processes and industries identified in the initial phase will be **extended** during the course of the project. At first, the scenarios of Supply Chain Management, Collaborative Product Development, e-Procurement and Portfolio Management will be investigated. Industrial requirements that are not fully covered by available scenarios will be anticipated through the Community Building Activities in Action

Line B. This continuous process of identifying further industries and processes ensures that the quality of scenario selection will be maintained for the whole duration of ATHENA.

2.2 R&D Projects

In Action Line A six research topics/projects were defined for the first stage of the IP. The definition of these R&D projects was based on the roadmaps elaborated by IDEAS (see Section 3.4):

- *Enterprise Modelling in the Context of Collaborative Enterprises* (A1) aims at developing methodologies for management and modelling of situated processes, flexible resource allocation and assignment. Furthermore, it investigates methodologies for work management and execution monitoring. For externalising the dynamic dependencies between participants and processes, methodologies of content based routing and collaborative processes will be developed. This project will enable scalable Enterprise Modelling methodologies and infrastructures, repository services and portal server services for "benefit driven Enterprise Modelling involvement".

- *Cross-Organisational Business Processes* (A2) deals with modelling techniques to represent business processes from different organisations on a level that considers the privacy requirements of the involved partners. Such models will have two perspectives: an enterprise modelling perspective that assigns a process to its context in the enterprise, and a formal aspect to perform computational transformations in order to allow for re-use of a process in a cross-organisational environment. Such models need to be enriched through ontological information and need to be executed through IT systems, such as workflow management systems. These systems need to be enabled to operate efficiently in an architectural environment that adapts to particular business scenarios.

- *Knowledge Support and Semantic Mediation Solutions* (A3) aim at the development of methods and tools for the semantic enabled enterprise, with a focus on supporting enterprise and application software interoperability. A key objective is to build an integrated software environment that is able to manage the semantics of different abstraction levels that can be found in an enterprise. Focus is to use formal semantics, organised in domain ontologies, to annotate the business processes and the software components in order to reconcile the mismatches that may be encountered in unanticipated cooperation activities.

- *Interoperability Framework and Services for Networked Enterprises* (A4) is concerned with the design and implementation of the infrastructure supporting interoperability in scenarios adopting the Integrated Paradigm (i.e. where there is a standard format for all constituent sub-systems) by enriching existing state-of-the-art interoperability architectures with enterprise semantics and models derived from the Enter-

[1] In the context of ATHENA Dynamic Requirements Process, a product is considered as a concrete implementation of a given solution, in particular the tools that can be produced by solution providers.

prise Interoperability Infrastructures of the organisations involved. The project will provide methodologies and develop seamless and configurable inter-connection software components. The resulting toolset will be the basic set of software and engines that is to prepare any enterprise in the adoption and exploitation of interoperability support infrastructures.

- *Planned and Customisable Service-Oriented Architectures* (A5) is to develop the understanding, tools and infrastructures required for service-oriented architectures which can be achieved more easily through the planning and later customisation of solutions for better application to user scenario requirements. Although the project will consider available business services, an increasing emphasis will be given to the development of an environment for easier application development that natively provides better customisation.
- *Model-driven and Adaptive Interoperability Architectures* (A6) is to provide new and innovative solutions for the problem of sustaining interoperability through change and evolution, by providing dynamic and adaptive interoperability architecture approaches. The project aims to advance the state-of-the-art in this field by applying the principles of model-driven, platform independent architecture specifications, and dynamic and autonomous federated architecture approaches, including the usage of agent technologies.

2.3 Remarks

Though the programme as a whole adopts a holistic perspective on interoperability, there is an initial emphasis of individual projects on **individual building blocks** rather than on achieving solutions that address interoperability in a holistic manner. However, the individual results of the projects taken together will eventually be combined to an **integral solution**.

Four out of six initial research projects (projects A1, A2, A5, and A6) address relatively focused topics. Project A3 is rather **supportive** in its focus on semantic issues that will be evaluated and used by all other projects. Finally, project A4 integrates the results and methodologies reached in the other projects. This project is a first **reconciliation attempt** that will provide an integral solution resulting in the ATHENA Interoperability Framework.

Major impacting results from ATHENA could be stated as follows:

- A generic, common platform for Networked Organisations, integrated by an open Infrastructure.
- Interoperability services to assist enterprise designers, knowledge workers and system developers in composing and adapting executable solutions, reusing knowledge and software components.
- Specific platforms built to support the research projects, the communities, use-cases, scenarios, test-beds, training and learning facilities, and collaborative experimentation.

2.4 Research Environment

ATHENA builds on results and experience of the thematic network IDEAS - Interoperability Development of Enterprise Applications and Software [5]. Goal of IDEAS was the definition of a roadmap for Interoperability of Enterprise Systems and Applications [4]. This roadmap was used in ATHENA to define the R&D Projects described in the previous section.
Furthermore, besides ATHENA the European Commission approved a Network of Excellence addressing a similar problem space: INTEROP (Interoperability Research for Networked Enterprises Applications and Software) [6] aims at integrating expertise in relevant domains for sustainable structuration of European Research on Interoperability of Enterprise applications. ATHENA is closely related to INTEROP.

3 Conclusion

This paper presented the EU project ATHENA that addresses Interoperability of Enterprise Systems and Applications. Its holistic approach and the individual research approaches and expected results were presented. Ongoing work focuses on research activities, building prototypes and applying them to pilot implementations.

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Towards Business Interoperability Research - Requirements Gathering and Analysis

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Abstract. This paper provides the context of ATHENA's activity in Business Interoperability Research. It describes the requirements gathering approach that has been adopted, documents the available preliminary findings, and identifies the main issues arising from the exercise.

1 Introduction

ATHENA (Advanced Technologies for Interoperability of Heterogeneous Enterprise Networks and their Applications) integrated project (IP) aims to be a comprehensive and systematic European research initiative in IT to remove barriers to interoperability, to transfer and apply the research result in industrial sectors, and to foster a new networked business culture.

This paper presents the approach of the activity within the ATHENA-IP (Activity B3) to requirements gathering for interoperability research from a business – as opposed to a technical – perspective. Secondly, it provides the preliminary results of the research work that has been accomplished to date. Thirdly, it highlights some of the major issues identified.

2 Approach to Requirements Gathering

The overall context of this activity is the future company, creation and management of dynamic collaborative networks, knowledge management to support innovation, and evolution towards digital ecosystems.

The objectives of this activity are to:

? Determine the strategic business challenges relating to interoperability.
? Provide a general model for determining the impact of interoperability on businesses.
? Apply this model to ATHENA for assessing the business impact of the ATHENA results.
? Provide policy recommendations to the European Commission in respect of interoperability.

The starting point of the research work is empirical. It gathers the business requirements for interoperability from a multitude of industrial sectors, using the following common analytical dimensions, at the organization, sector, and cross-sector levels:

? Time.
? Value.
? Market structure.
? Role.

Requirements are further distinguished between those pertaining to the present situation and those relating to future scenarios (2010). The results are then consolidated and assessed for identifying the drivers that determine the choice and implementation of interoperability technologies, both now and in future.

3 Preliminary Results

Preliminary results have been or are being gathered for the following sectors / organizational forms:

? Telecoms
? Software intensive organizations (small, medium, large)
? Manufacturing
? Building and construction
? Research organizations
? Furniture
? Industrial districts
? Automotive
? Public sector
? High tech industries
? Off-shoring organizations
? Textile

A synthesis of the available preliminary results will be presented in a future version of this paper.

4 Main Issues

The main issues that have been identified are:

- A vast body of related state-of-the-art, but with little / insufficient concrete conceptual grounding in the specific subject of business interoperability.
- Considerable gulf between the business domain and the technology domain, and between actual market experiences and research efforts.
- The socio-economic aspects of interoperability are broad and wide ranging, and impact analysis must be based on a critical mass of empirical data, which is not always readily available or easily shared.
- Structural change in many sectors and markets leading to questions of:
  - How to find a common ground in interoperability?
  - How to move ahead with some degree of certainty?
- A long term timeframe is needed for achieving results – years not months.

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