

Proceedings of the I-ESA'07 – condensed version

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The 3rd International Conference on *Interoperability for Enterprise Software and Applications*, was held in Funchal, Madeira, Portugal, on 2007-03-28/30, Participation: 430 people.

The conference was organised in 3 plenary sessions fostering 7 keynotes and 31 parallel sessions with a total of 94 papers. The parallel sessions addressed various research areas (modelling and engineering, architectures, formal approaches, model driven and service oriented integration and development, tools and methodologies – 56 papers), covered different aspects of interoperability (semantic and knowledge, managing, measuring and validating, cross sector – 26 papers), and presented selected case studies and identified relevant work in standardisation – 12 papers.

The conference papers have been gathered in the proceedings entitled “Enterprise Interoperability II: New Challenges and Approaches”, edited by R.J. Gonçalves, J.P. Müller, K. Mertins and M. Zelm, published by Springer-Verlag London Ltd. 894 pages, ISBN978-1-84628-857-9.

In the following a condensed version of the proceedings is presented following the table of content of the proceedings.

Part I Enterprise Modelling and interoperability engineering

Weber formulates a list of 14 requirements for service composition in the contexts of business process implementation, enterprise application integration, and interoperability, which could increase significantly the automatic composition of semantic web services relevant for enterprise application integration. A starting point for a composition approach and a short analysis of the computational complexity is provided. **Mayer et al** discuss the use of requirements engineering techniques, for solving business/IT interoperability issues together with the clarification of the underlying security risk management ontology. **Feltus & Rifault** propose a method for constructing policy models to complement business process models by recognizing manager's responsibility for values of process deliveries. An ontology is defined for interoperability between models of different organizational levels. **Jochem & Knothe** describes analysis results of different cooperation forms according to advantages/chances, disadvantages/risks, requirements for interoperability, requirements for models and requirements for quality management. Requirements are derived from business motivation, corporate infrastructure and cooperation dimension. The analysis also includes the use of a quality model developed by ATHENA-IP for interoperability, which should be used for interoperability audit/assessment of the capabilities for networked enterprises. **Walter et al** present a concept for P2P based model management for cross-organizational business processes, including distribution of process modules and their composition to cross-organizational super-processes. The technical and conceptual feasibility of the approach will be verified by a prototype (under development). **van den Heuvel & Jeusfeld** introduce and explore an extension to the existing paradigm of model transformation by considering reference models and human input as important sources for and during model transformation. The authors developed an approach grounded on a common generic model and a series of transformation operators, which constitute a non-trivial extension to the “classical” model management operators. **Matulevičius et al** analyse and compare syntax and semantics of GRL (Goal-based Requirements analysis Language) and KAOS (Knowledge Acquisition in automated Specification) using the UEML (Unified Enterprise Modelling Language) approach, providing a systematic and detailed comparison of the two languages.

Costa et al propose a framework and method for an integrated solution, which enables design and enactment of cross-organisational business process using new tools for modelling and execution based on the service-oriented architecture (SOA). The solution has been validated in the furniture e-procurement domain. **Lange & Rüppel** provide engineers in the area of fire protection planning with integrated views on the relevant technical planning information. Focus is on an agent-based approach for model integration and on the interoperability on the semantic level. To provide engineers with integrated transparent views on the model data, domain specific ontologies and mappings between these ontologies and different database schemas have been developed. **Nurcan** has the objective to measure the capacity of modelling solutions to represent flexibility requirements of intra- and inter-organisational business processes. First results of a literature survey are presented. **Grangel et al** identify and analyse a number of enterprise and system modelling approaches, categorise their concepts at the SOA CIM level and investigate the strategies and mechanisms employed for bridging the gap to the PIM level. The objective is to improve model driven interoperability methodology. **Grandin-Dubost et al** demonstrate the use of an Interoperability Implementation Assessment Model (IIAM) using an e-procurement scenario and investigating the impact of web services implementation. The result indicate improvement of information reliability, speed-up of transaction processing and reduced transaction cost.

Part II Distributed, decentralised and adaptable interoperability architectures

Samsonova & Schroth elaborate on the goals and paradigms of the newly established Enterprise Interoperability Center (EIC) in view of achieving joint agreements between a critical mass of companies on the implementation of an adequate standard for enterprise application integration. **Roser & Bauer** present an approach of ontology-based model transformation using the capabilities of semantic technologies in model-driven development and discuss its improvements for collaborative modelling. **Müller et al** propose a service oriented domain architecture (SODA), which aims at supporting web service requirements for workflow systems of different domains by introducing a domain manager as a new role in SOA. **Hofbauer & Negretto** introduce business modelling in supply network by decomposition into a set of sub-models representing different views of the network and superimpose the view models to create the overall model. As an example a multiple partner Kanban process in a supply network has been modelled. **Ruokolainen et al** present a model of interoperability for service-based inter-enterprise computing environments, which is based on an extended ontology of interoperability to enable the representation of dynamic aspects. **Stiefel & Müller** describe the overall system architecture of a P2P product collaboration platform and its key elements, which will enable loosely coupled interactions between partners in a decentralise environment. Part of the concept has been proven by a prototype implementation. **Naumenko et al** describe their long-term vision for the security and privacy management in complex multi-agent systems like UBIWARE (Smart Semantic Middleware for Ubiquitous Computing), and present the SURPAS security framework for smart ubiquitous industrial resources. **Hahn et al** present a platform independent metamodel for agent systems that abstracts from existing agent-oriented platforms and illustrate an agent-oriented software development process in accordance to the model-driven development (MDD) approach that could be formulated around the abstract view on agent systems and thus (i) further the development process of agent systems to increase the interoperability among agent platforms and (ii) facilitates the interoperability of agent platforms and potential areas of application. **Kahl et al** present an architecture for design and agent-based implementation of cross-organizational processes and describe the conceptual preparation of such processes independently from specific techniques used for their execution. A prototype has been realised. **Cui & Song** developed and

tested a data grid for collaboration development in virtual enterprises in China aviation companies (*paper not presented at the conference*). **Eder et al** report on a conformance test of federated choreographies to check their structural conformance and orchestration of the proposed model. The authors claim to formally check whether an orchestration realizing (one part of) choreography, resp. two related choreographies fit together.

Part III Tools and methodologies for enterprise interoperability

Anaya et al present an extended quality framework based on UEML (Unified Enterprise Modelling Language) for evaluation of enterprise modelling languages. Existing quality frameworks for assessing data model and software product quality have been investigated leading to a taxonomy of appropriateness categories for quality characteristics. **Mouzatikis et al** report on a common repository for governmental data. The modelling framework (GENESIS) and its data modelling methodology have been applied in the Greece INTRASTA Statement – a means to collect information for the statistics on import/export of goods between European member states. **Hauge et al** introduce an initiative for improving SME collaboration by introducing a business process reference model and an open source based collaboration tool with ERP/CRM functionalities. **Rajsiri et al** present a 3-step approach to identify requirements, establish the process and design the supporting information system in business collaborations. **Chapurlat et al** describe the construction of a manufacturing ontology based on some selected standards of manufacturing models and languages (e.g. PSL, ISO 19440, ISA 95, UEML, UML; OWL), in an application utilizing software agents. **Blanc et al** propose a graph-based approach for evaluation of interoperability between humans. A GRAI Grid based example is described. **Costa et al** discuss results achieved in information modelling applying the ontology based ISO 10303-AP236 standard, which specifies product component characteristics and rules for product definitions (product classes) (*paper not presented at the conference*). **Schumacher and Feurstein** discuss the living lab concept with focus on user integration and comparison of different customer integration methods (*paper not presented at the conference*). **Velardi & Sclano** present TremExtractor a web application for extracting multi-word expressions from literature to establish domain terminology. **Xu et al** address a Service-oriented Model Driven Architecture (SMDA), which extends UML to USML to describe service models and supports the interoperability between heterogeneous service models, uses service component to build service system and adopts a QFD (Quality Function Deployment) based service evaluation method to evaluate the service models and service system. **Mertins et al** describe an approach for achieving interoperability in an incremental way, which is based on four interrelated aspects: interoperability architecture, business scope of interoperability tasks, interoperability maturity level and an establishment framework. The approach is applied to support modelling of production networks for requirements elicitation for an ASP (Application Service Provider) platform. **Jeusfeld et al** proposes the structure for a so-called method chunk repository that contains instructions on how to solve interoperability problems between organizations and their information systems. A classification framework associates method chunks and application cases to re-occurring interoperability problems.

Part IV Semantic and knowledge aspects in enterprise interoperability

Bogdan et al discuss a method for ontology development using a concern-oriented approach for information system analysis identifying shared and specific vocabularies. The method has been applied in a case study in a hospital environment. **Cardoso** presents a four layer Semantic data Integration Middleware (SIM), which uses an ontology-based multi-source data extractor/wrapper approach to transform data into semantic knowledge. SIM when based on a

single query integrates data residing in different data sources. **D'Antonio et al** describe the formalisation (using OWL) of e-business design patterns for OPAL (Object, Process, Actor modelling Language) an ontology-modelling framework that aims to support business experts in building ontologies. **Hamri et al** propose the use of a MDA (Model Driven Architecture) defined ontology architecture together with MOF (Meta Object Facility) based workflow meta-model and an OWL ontology to support workflow interoperability. **Gionis et al** identify the need for incorporating legal rules to ensure interoperability for cross-border e transactions and present a legal rules meta-model. **Barkmeyer & Denno** propose documentation of information requirements by a methodology for specifying the needed information flow in joint business processes, which will consist of a reference ontology for business entities, a formal specification of the processes and a binding between process elements and business entities. **Huza et al** describe OntoMas (Ontology Matching Assistant) a tutoring system, which will propose an architecture, develop a knowledge-based system for description and classification of matching methods and provide functionalities for user guidance in matching method selection. **Söderström & Meier** aim to develop a model for facilitating interpretation and comparison of SOA (Service Oriented Architecture) maturity models (SOAMM). After some general remarks and the description of 2 models (SOAMM and SIMM - Service Integration Maturity Model) the authors present a combination of these two models as CSOAMM (Combined SOA Maturity Models), which allows comparison of SOA maturity models. **Dorn & Naz** developed a prototype for integrating information of different job portals into one meta-search engine. The current focus is on the automated extraction of the structure of provided information. The vision would be to generate agents that can supply available jobs dynamically with a web service interface.

Part V Model driven and service oriented integration and development

Pataki et al present results from the Application Bus for Interoperability In Enlarged European SMEs (ABILITIES), which consist of design and implementation of a federated architecture based on UBL (Unified Business Language) active messages to support Order-to-Invoice processes. Groupware and multimedia tools are used in the implementation. **Bastida & Nieto** propose to apply the product line engineering (PLE) approach to dynamic context aware service composition both at design- and at run-time. **Jiménez & Espadas** describe the implementation of a visual tool to simplify enterprise application integration to an e-service hub based on web technologies and the Software as a Service (SaaS) concept (*paper not presented at the conference*). **Grangel et al** present a proposal, called Model Driven Interoperability (MDI), for transforming models at different levels of abstraction focused on interoperability issues. Example: SOA CIM-level transformation of GRAI actigrams into UML activity diagrams. **Zhan et al** propose an interoperability oriented business object model as an MDA (Model Driven Architecture) intermediary level between the SOA CIM process oriented model level and the PIM object oriented model level, which abstracts process information into a Business Object (BO) and maps business activities into BO activities. **Jonkers et al** show how functional and non-functional aspects as well as their analysis can be considered in an integrated way in model driven Design, Execution, Analysis and Monitoring (DEAM). The DEAM framework has been tested in a real life example. **Schroth et al** report on the design and deployment of an e-Business platform that removes entry barriers for SMEs by providing users to seamlessly model and set-up business relations with other users and execute these on the basis of a collaboratively designed standard. Cross-organisational interoperability is achieved on both business process and data level, the authors propose a novel, integrated modelling concept which is partly based on different existing standards such as the ISO 15000-5 Core Component Technical Specification (CCTS developed by UN/CEFACT). **Onofre et al** propose a methodology to support the

implementation of conformance testing in B2B applications in the STEP environment, which is based on ISO/IEC 9646-3 Tree and Tabular Combined Notation (TTCN). **Miletic et al** describe results from the development of transformation tools that enable the use of RDF-based Semantic Mediation tools for integration of business applications that required XML to RDF, RDF to XML, and the XML Schema to the RDF Schema transformations. **Chaari et al** propose an architecture for a service-oriented enterprise based on business component identification with two levels of abstraction: IT services and business services, which allow to distinguish between business components and business objects. **Pokraev et al** provide a technique for business expert to model application services at a high level of abstraction as well as their orchestration and the mapping of the required information. A mediation framework will transform the models to the orchestration technology. **Álvarez et al** report on a proposal for interoperability of transport companies fleet management system between drivers, suppliers and customers, using the service oriented architecture concept.

Part VI Collaborative architectures and formal interoperability approaches

Gionis et al present a hybrid e-business architecture, which is based on a central repository of modelling building blocks and employs P2P type interactions. **Heinonen et al** show how the tool chain infrastructure, where tools supporting different phases of the development life cycle, supports efficient use of resources and transparency in collaborative software development. **Jankovic et al** describe the validation of POP* the ATHENA enhanced modelling solution for interoperable cross-enterprise data exchange using an e-Kanban replenishment process and the data interchange protocol standardised in the Inventory Visibility and Interoperability project (IV&I). **Tolle et al** provide an overview of the federated integration approach based on the Enterprise Service Bus (ESB) for Enterprise Application Integration (EAI) and the Universal Business Language (UBL) developed and used in the Interoperability In Enlarged European SMEs (ABILITIES) project. A core component is the ESB based ABILITIES Interoperability Bus (AIB). Also a comparison with the Danish Service Oriented Infrastructure for B2B application is provided, which is seen as being complementary to the ABILITIES work. **Chituc et al** present a two-layered operational infrastructure (messaging and business process layer) aiming at achieving seamless interoperability in collaborative networks of the shoe manufacturing up-stream segment, which has been developed within the scope of CEC-made-shoe European Integrated Project. **Berre et al** describe the ATHENA Interoperability Framework (AIF) for enterprise applications and software systems, which provides a compound framework and associated reference architecture for capturing research elements and solutions like interoperability profiles to interoperability issues that address the problem in a holistic way. The AIF also provides an associated methodological framework, which describes the approach towards interoperability together with reference guidelines for the adoption of the reference architecture. **Ospina & Charlier** discuss precise descriptions for programming languages to achieve their interoperability and propose a framework based on structural operational semantics to describe general interoperability mechanisms. **Gunendran et al** explore problems within manufacturing information systems and discuss the requirements for a methodology to improve the consistency of information sharing and hence interoperability. Focus is on information organisation highlighting that information classification, context dependency, context relationships and semantics are all critical in manufacturing interoperation. PSL (Product Specification Language) and UML2 are identified as potential solutions. **Lagerström et al** propose a method for interoperability knowledge elicitation from scientific text generating extended influence diagrams.

Part VII Managing, measuring and validating interoperability

Kürschner & Thiesse investigate the example of Metro Group in order to make statements on the need for interoperability in the retail supply chain. The authors apply BIF (Business Interoperability Framework) for interoperability assessment, discuss the causes and motives for sub-optimal interoperability ratings and outline areas for improvement for the given scenario. **Forcada et al** develop an ontology and a decision-making tool to analyse environmental and health and safety risks in the construction industry and define technical solutions and preventive measures. **Chapko et al** present a case study in the German health care system to demonstrate the value of interoperability in networked enterprises by comparing transaction cost before and after relevant investments. **Mariategui & Kallinikos** report on a case study with a global semantic web content provider (BBC) concerned with interoperability in the new media environment. Three different prototypes of new web services (mashups), which support the combination of information coming from different data sources with different representations, have been analysed and interoperability issues identified. **Kutvonen** discusses a major change in interoperability goal (from integration to unification, to federation) and outlines a B2B middleware solution for agile management of interoperability knowledge. **Kabilan et al** propose a common non-functional aspects oriented ontology together with a series of specialised ontologies, which cover such non-functional aspects as trust, risk, privacy, etc. **KIM & Kulvatunyou** describe an approach where test results and traces from both conformance and interoperability tests are analysed for potential interoperability issues. Result from a case study show that more interoperability issues in B2B applications can be resolved in the lower-cost conformance testing mode leading to cost savings for achieving interoperable solutions. **Snelick et al** present a methodology based on message profiles for defining, implementing, and testing HL7 interfaces. A collection of tools has been developed to facilitate the use of message profiles and to improve interoperability among healthcare systems.

Part VIII Cross sector Interoperability

Jeong et al propose a novel interoperability test framework supporting verification and correction activities. The framework provides interoperability tests by performing a pair of application output- and input conformance tests. An exemplary case study for secure messaging between web service applications is demonstrated. **Durand et al** propose a new approach for conformance and interoperability testing of today's e-business technologies to improve existing, test scripting languages and operation modes. A test model and the Event-driven Test Scripting Language (eTSL) are described and examples are provided that illustrate the use of both the model and the language. eTSL is intended to be submitted to OASIS for standardization. **Blommestein & Broeksema** report on a methodology to generate web forms for business documents directly from XML schemas that are based on the UN/CEFACT Naming and Design Rules to be employed in an UN/CEFACT Core Components environment. **Stäber et al** study the interaction between an Automotive Original Equipment Manufacturer (OEM) and a large supplier network consisting of first, second and nth tier suppliers, in the process of strategic sourcing within Collaborative Product Development (CPD). The authors present an architectural framework and methods supporting the process driven environment and solutions supporting the event driven environment, and show how both segments of the virtual enterprise network can be integrated, providing a higher level of interoperability throughout the entire process. **Novici, et al** present an overview of an open source and web technologies based approach for B2B interoperability demonstrating its capability using e-Kanban messages in an inventory replenishment application. **Lebreton & Legner** propose an interoperability impact assessment

model (IIAM) together with a framework providing strategic, operational and financial indicators. **Jun et al** describe a primitive ontology model proposed for product life cycle meta-data in the resource description framework (RDF) to be employed in closed-loop PLM applications. **Berre et al** report on an architecture for Systems of AMBient intelligence enabled by Agents (SAMBA). Distinction between types of interoperability: business (inter-organisational processes), technical (knowledge format, schema, ontology) and semantic interoperability. Parts of SAMBA have been completed. **Gruhn & Schäfer** apply a simulation approach to determine the desired properties of mobile systems (like quality of service parameters) using the own developed architecture description language (Con Moto) able to represent both behavioural and structural system specifications as well as physical and logical components.

Part IX Applications, case studies, best practice and standards

Klein et al apply ATHENA results in the area of Cross-organisational business process to enable interoperability in multi-brand vehicle configuration using a service oriented approach to integrate the various car manufacturer systems and a SAP tool set for harmonising the customer and dealer processes. **Rolfesen et al** present a combination of Model-Generated WorkPlaces (MGWP) in tandem with Service-Oriented Architectures (SOA) to meet interoperability needs in a corporate environment and discuss its benefits and limitations. **Bazijanec et al** identify relevant influencing variables that determine the integration effort in a real world data integration scenario. Different versions of an integration toolset are evaluated with respect to effects on the integration effort based on data that was collected during the project to specify integration efforts over the entire project term and also provide an indication for integration costs. **Lukáscy et al** describe a composed-based enterprise information integration system (SINTAGMA), which supports the semantic integration of heterogeneous information sources by collecting and managing meta-information on the sources to be integrated. **Ilat & Macit** present the integration of the Educational Simulation Tool for Architectural Room Acoustics (ESTARA) with Computer Aided Architectural Design (CAAD) tools using ifcXML schemas a standard developed by the International Alliance for Interoperability (IAI) (IFC - Industry Foundation Classes) (*paper not presented at the conference*). **Schreiner & Hrastnik** report on a web service environment analysis framework that supports web service evolution monitoring. 5 issues relevant in service evolution are identified and discussed: service composition, changes, views, evolution metrics and evolution management. **Agostinho et al** propose to apply MDA and Model Morphism methodologies for the manipulation and transformation of STEP conceptual models to more widespread implementation oriented technologies, such as XML or OWL, easier to adoption by smaller organizations. This approach is being validated in industrial scenarios in the European research project, ATHENA-IP. **Beardsmore** addresses schema description with DFDL (Data Format Description Language) for arbitrary data formats and provides a working example. DFDL is under development by the Global Grid Forum. **Wilkes et al** propose a web service for product data exchange to resolve concept identifiers in respect to their meaning and to their machine interpretable representation by providing 3 different information response layers: location of reference dictionaries, terminology references, and data model. Final design of the web service is under development in TC 184 SC4/WG13. **Radoiu** provides guidelines on analysing small virtual team software development process performance using the workflow model and meaningful measurable elements, which provide more insight into the process. A limited quantitative survey was used to test the conceptual model and hypotheses of the study. **Greiner et al** systemize typical interoperability issues from a business perspective (described by seven Business Interoperability Profiles) and identify appropriate interoperability solutions, which may solve

these issues. It extends previous interoperability research by linking the technical view on interoperability to business drivers and needs (ATHENA IP). **Izza et al** delineates a service-oriented approach for structuring an enterprise architecture, called service-oriented urbanism. It extends the traditional information system urbanism and enterprise architectures in order to derive service clusters that structure services in a flexible way. Several experiments with small cases have been performed.