

INTEROP-ESA'2005, Summary of Papers

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The INTEROP-ESA'2005, 1st International Conference on *Interoperability of Enterprise Software and Applications*, was held in Geneva, Switzerland, on 2005-02-23/25. During the conference 56 papers have been presented in 12 general sessions, 2 sessions on R&D in the IST programme and 4 special industry sessions. The papers presented in the general session addressed a wide range of subjects relevant for enterprise software and application interoperability like frameworks and architectures, meta-models, ontologies, infrastructures and tools, standards, technologies and applications. The R&D project covered Semantic Web, cross-organisational collaboration, standardisation, research in interoperability, enterprise and integration and eGovernment. In the following titles, authors and very short abstracts of the papers held in the different sessions are presented.

General sessions (35 papers)

Framework and Architecture (3 papers)

1) MAFIIA - an Architectural Description Framework: Experience from the Health Care Domain (Walderhaug et al), defines a reference architecture and a set of viewpoints¹ (context, requirement, component, distribution and realisation view). Four logical tiers (user interface, user service, business service and resource service) and an interface to the environment are the main components of the reference architecture. MAFIIA has been applied in two health care related case studies. 2) A Framework to Support Interoperability Among Semantic Resources (Lima et al), reports on a feasibility study of an open semantic infrastructure for the European construction industry. The framework contains three domains: user, application and resource. Semantic resources are described by meta-schemas and schemas thereby providing for the mapping between such resources. 3) Quantitative Analysis of Enterprise Architectures (Jacob et al), provides an approach for a quantitative analysis of layered, service-based architecture models, which follow a two-way parameter propagation: top-down of workload and bottom-up of performance and cost. A set of views and relevant performance measures are defined: user/customer \downarrow response time, process \downarrow completion time, product \downarrow processing time, system \downarrow throughput, resource \downarrow utilisation. An example from an insurance company illustrates the analysis method.

Meta-model (3 papers)

1) Development of a meta-model to foster interoperability along the product lifecycle traceability (Terzi et al), proposes a holonic model, which defines in its object information class all the information needed to ensure product forward and backward traceability throughout its life cycle. References are made to ISO standards like ISO 103003 (PLCS), 15531 (Mandate) and 62264 (Enterprise Control Systems Integration) and other standards (PLMQXML, PML – Physical Mark-up Language). 2) Mapping Specification in MDA: From Theory to Practice (Lopes et al), proposes a Meta-model for mapping specifications between two meta-models and a tool to support this mapping. 3) Development of an Integrated Retrieval System on Distributed KRISTAL-2002 Systems with Metadata Information (Nam et al), the Korean information system utilizes integrated metadata and mapping information between the meta data and actual data base schema information of the systems involved in exchanges. An implementation of six different data bases distributed across different sites is described.

Ontologies (5 papers)

1) Onar: An Ontologies-Based Service Oriented Application Integration Framework (Tektonidis et al), utilizes web ontologies to create semantic conceptualisations of the business concepts inside an application, which are used for creation and registration of web services in a UDDI based registry. 2) A Unified Framework for Enterprise Integration An Ontology Driven Approach (Izza et al), extends the Service Oriented Architecture (SOA) with a semantic layer, which consists of two sub-layers: an ontological and a mediation layer. The first sub-layer consists of three main service types: data, functional and business services, whereas the second sub-layer provides only a mediation services. 3) Ontology-based Interoperability Services for Semantic Collaboration in Open Networked Systems

¹ Viewpoints seem to relate to life cycle

(Castano et al), characterises discovery and matchmaking interoperability services for retrieving information resources semantically related to a target request, which enable a coordinated and virtualised access to distributed heterogeneous information resources. 4) Ontology-based Semantic Interoperability Tools for Service Dynamic Discovery (Bianchini and De Antonellis), proposes a service ontology architecture, which organises services at different layers of abstraction according to their semantic relationship in order to enable selection of the best service for a given service request. 5) Identifying Business Components on the basis of an enterprise Ontology (Albani and Dietz), introduces a process for business component identification and provides an example of modelling a business domain for strategic supply network development. It concentrates on the domain scope and the component identification sub-phases of the process.

Infrastructures and Tools (9 papers)

1) Modeling and using business collaborations (Bruno), presents a software environment, which allows to experiment with business and collaboration processes. The role of the latter is that of an interface to ensure messages to be exchanged in proper order and time. 2) Establishing Interoperability of Coordination Protocols in ad-hoc Inter-Organizational Collaborations (Bazijanec et al), defines a process to establish ad-hoc collaborations, which describes the necessary steps for an automatic construction of an agreed coordination protocol addressing both business related and communication related tasks. 3) An M3-Neutral Infrastructure for Bridging Model Engineering and Ontology Engineering (Bézivin et al), uses meta-meta models to enable the bridging between the two engineering domains, whereas the use of meta models may be quite costly and not scaleable. The results obtained may be applicable in other domains as well. 4) Contract-Based Interoperability; For E-Business Transactions (Artyshchev and Weigand), classifies characteristics of levels of contract-based interoperability by introducing 6 levels: functional verification, transactional interoperability, contract enabling, contract monitoring, and contract adaptation, full contracting. 5) Interoperability middleware for federated enterprise applications in web-Pilarcos (Kutvonen et al), the B2B middleware platform ensures technical, semantic and pragmatic interoperability in a federated mode between business applications in an inter-organisational context. The following functionalities are provided: service discovery, contract based collaboration management, monitoring of contract performance. 6) Interoperability Issues in Metamodelling Platforms (Kühn and Murzek), describes a generic platform and identifies interoperability issues, which are also illustrated by a case study from the insurance sector. The latter integrates four meta models into an integrated meta model. 7) WSMB: a middleware for enhanced Web services interoperability (Kien et al), a Web Services Messages Bus is described, which serves as an integrating framework for web service interactions. 8) A Conceptual Model for the IST Infrastructure (Goossenaerts), explores three missing components of an infrastructure for interoperation: total asset management, extended generic activity model and a concept for token-based execution in knowledge management and proposes solutions. 9) Towards a new infrastructure supporting interoperability of information systems in development: the Information System upon Information Systems (Le Dinh), proposes a conceptual framework for building and maintaining information systems.

Standards (6 papers)

1) Business Process Requirements, Modelling Technique, and Standard: How to identify interoperability gaps on a process level (Rukanova et al), proposes a framework that evaluates the matching of business process requirements, modelling techniques and standards using an ontology-based set of constructs. Basic concepts have been identified. 2) An Architecture for Semantic Enterprise Application Integration Standards (Anicic et al), describes an approach to enable automatic checking of compatibility among rules and constraints within standards that have a common terminology but are developed independently. The approach has been applied to business documents from two organisations in the automotive industry, both following the XML Open Architecture Group Business Object Document standard (OAG-BOD). The OWL-DL web ontology language is used to integrate the application. 3) ISO Standards for Interoperability: a comparison (Kosanke), discusses inconsistencies in the definitions of interoperability and reviews the content and identifies differences in two ISO standards (ISO 15745 and 16100), both defining profiles for enhancing interoperability between devices (ISO 15745) and manufacturing software units (ISO 16100). Differences in the contents of the two profiles are partly due to their different scopes, but also to inconsistencies in terminology, structure and rules. 4) Towards Using UML 2 for Modelling Web Service Collaboration Protocols (Kramler et al), proposes a platform independent modelling technique for modelling of cooperation, which sup-

ports three levels of abstraction: collaboration, transaction and interaction. Each of the three levels and their constituent models are described in detail 5) Methodology for the definition of a glossary in a collaborative research project and its application to a European Network of Excellence (Velardi et al), is based on method of the University of Rome for semiautomatic acquisition of terms and definitions from documents. The paper describes the different steps of the 4-stage methodology and its application in the INTEROP project. The OntoLearn system, a collection of ontology building algorithms and tools has been used to build a domain ontology relating domain terms to concepts and conceptual relations to the WordNet lexicalised ontology. Current status of the effort is a hierarchically structured glossary of about 280 terms and definitions. 6) Using Connectors for Deployment of Heterogeneous Applications in the Context of OMG D&C Specification (Bulej and Bures), uses software connectors according to the OMG Deployment and Configuration specification in order to overcome incompatibilities in component models, which are to be used in heterogeneous component applications. Software connectors are middleware independent and provide additional services like adaptation and monitoring. The paper provides an overview of the OMG specifications and some details on connector preparation and instantiation.

Technologies (5 papers)

1) Interoperability through integrating Semantic Web Technology, Web Services, and Workflow Modeling (Krogstie et al), reviews the basic technologies and outlines future potentials of their merging. An interoperability pyramid identifies 5 levels of interoperability, which are further described by means of a three layer model: i) ICT, ii) Knowledge and iii) Work and management layer. 2) Transforming Workflow Graphs (Eder et al), defines an equivalence for workflow graphs and provides a set of basic transformation operations, which allow the changing of a workflow representation without losing its semantics. 3) Integrating Business Processes with Peer-to-Peer technology (Kupsch and Werth), allows a holistic integration of data, applications and business processes by introducing P2P adapters, which enhance the functionality of the single component with additional web services. The adapter architecture consists of four APIs: configuration, business, search and monitoring and control. 4) Design and Implementation of a Peer-to-Peer Data Quality Broker (Milano et al), a service, which allows to access data in a distributed corporate information system and improves data quality by comparing different copies of the same data. Experiments with real data show the service effectiveness and performance behaviour. 5) Moving from Internal to External Services using Aspects (Henkel et al), describes aspect oriented programming, which will facilitate the implementation of requirements arising from the move from internal to external services.

Applications (4 papers)

1) Inter-Organization Interoperability in Transport Chains Using Adapters Based on Open Source Freeware (Davidsson et al), describes a general adapter, which should allow any two businesses to exchange transport relevant information via web portals, e-mail, fax and SMS. The adapter consists of a bridge, an interpreter and a message handler and the pilot study tested prototype software is available for free. 2) Virtual Breeding Environment: A First Approach to Understand Working and Sharing Principles (Sánchez et al), presents results from an action-research effort that will define main elements for a virtual breeding environment such as actors, knowledge sharing, organisational structure and culture. 3) Experiment in Model Driven Validation of BPEL Specifications (Akehurst), uses UML and OCL to provide a model of the XML-based Business Process Execution language (BPEL). From this specification a validation tool is generated automatically, which will check on the quality of BPEL documents. 4) Design Solutions for Interoperability using a Process Manager (Johannesson et al), addresses three issues of process manager technologies: (i) need for business oriented notation of business processes, (ii) needs for trace of design decisions, (iii) need for information correctness and proposes different solutions for applications in the healthcare domain.

R&D in the European IST Program (7 papers)

1) The Knowledge Web Network of Excellence (Franconi), is a Network of Excellence, which is involved in strengthening the European industry in using the semantic web for e-work and e-commerce. Activities are related to industry (awareness and take-up of the technology), education (establishing a Virtual Institute) and research coordination (avoiding duplication and fragmentation). 2) Interoperability Contributions of CrossWork (Mehandjiev et al), focuses on interoperability issues in cross-organisational applications in the areas of semantic and process interoperability. The former uses ontologies, meaning negotiation processes, formal concept analysis and lattice theory aiming at

automatic reasoning. The model, named *devolved ontologies*, integrates approaches to ontology engineering. Process interoperability relies on the Petri-net-based process-modelling framework XRL and agent technology to achieve team and workflow coordination. 3) *Networked Organisations – Research into Standards and Standardisation (NO-REST)* (Blind and Jakobs), studies the evolution of standards and their implementation in a dynamic environment as well as their supply by SDOs and consortia and their markets. 4) *Methods for the Analysis of Supply Network Processes at European SMEs* (Rabe), presents techniques to support cross-enterprise business process modelling, which has been used in three company networks within different European regions. An ASP platform has been used for data exchange and IEM and SCOR for the business process modelling. The SPIDER-WIN project has demonstrated that a well-adapted reference model is an important base for such business process studies. Analysis of initial results, indicate potentials for improvement as well as constraints for more sophisticated supply chain controls. 5) *INTEROP Network of Excellence* (Bourrieres), has the goal to sustainably structure and shape the European research activities on enterprise interoperability for enterprise applications and software. Activities are in three areas: (i) enterprise modelling – define requirements and support implementation, (ii) ontology - identify semantics in the enterprise and (iii) architectures and platforms - provide implementation frameworks. 6) *ATHENA – Advanced Technologies for Interoperability of heterogeneous Enterprise Networks and their Applications* (Ruggaber), is an industry driven Integrated Project (IP), which will provide reference architectures, methodologies and infrastructure as well as business results supporting ROI calculations and predictions for impact of new technologies. In its action line on R&D, ATHENA addresses six different subjects to support interoperability: (i) enterprise modelling, (ii) cross-organisational processes, (iii) knowledge support and semantic mediation, (iv) framework and services for networked enterprises, (v) planed and customisable SOAs and (vi) model-driven and adaptable architectures. Prototypes and pilot implementations will validate and demonstrate ATHENA results. 7) *Terregov: eGovernment interoperability on a semantically driven World* (Vicente et al), aims to enable local governments to deliver online services, especially in the social care environment. Web services and text documents will be described using an ontology, which is supposed to provides the language independent mechanism needed to support automatic discovery in answering citizen requests. Answers have to be provided regardless of the particular administration providing the service. Implementations of project results take place in different European administrations in the social care domain.

Industry sessions (14 papers)

Architectures and Frameworks (4 papers)

1) *Enterprise Architectures – Survey of Practices and Initiatives* (Lillehagen and Karlsen), provides an overview of current practices and development initiatives in the field of Enterprise Architecture, and on ongoing initiatives to transform from the current use of architectures, to those that guide and support new ways of developing, executing and managing computing solutions. 2) *Towards an Interoperability Framework for Model-Driven Development of Software Systems* (Elvesater et al), will support the business inter-operability needs of an enterprise with a set of reference models, which support conceptual, technical and application integration. 3) *A Collaboration Framework for Cross-enterprise Business Process Management* (Adam et al), for the planning, implementation and control of cross-enterprise business processes. The framework distinguishes between global knowledge within the network and local knowledge of each participating company and employs a process life-cycle model. 4) *An Agent-based DES Supported Modelling Framework for Enterprises* (Caramihai), is intended to provide generic models, allowing evaluating interactions among different subsystems. Evaluation is on two key properties: meeting a given deadline for the whole process and allowing certain undesirable states as mutual blockings.

Applications, Infrastructures and Case Studies (7 papers)

1) *An Empirical Study of the UML Model Transformation Tool (UMT)* (Gronmo and Oldevik), presents the open source tool UMT that uses UML models to support a model-driven development process enabling definition of transformations for code generation, reverse engineering or model-to-model mappings. UMT has been evaluated against a set of desired properties for UML transformation in accordance with ongoing work in the OMG. 2) *SFIDA: interoperability in innovative c-business models for SMEs through an enabling Grid platform* (Aldenucci), reports on the objectives of the project “SFIDA”, which aims at developing a GRID-based inter-operability platform able to support next generation Supply Chain Management applications specifically addressing the needs of SMEs belong-

ing to industrial districts and dynamic supply networks. 3) *Syndicate Data Incorporation into Data Warehouses: Contrasting Consumer Problems with Supplier Viewpoints* (Strand and Lundel), show that user organizations and syndicate data suppliers have interoperability issues with respect to the business and knowledge layers, whereas the interoperation on the ICT-systems layer seems to be prioritised and therefore achieved a higher degree of interoperability. 4) *Conformance Testing of Open Interfaces in Healthcare Applications - Case Context Management* (Toroi et al) describe the conformance testing model needed to improve software interoperability. Developed and applied in the PlugIT project, the model has been evaluated in several hospital districts and with various proprietary products. 5) *Design anywhere, Build anywhere* (Wayell), presents a case study of a large UK Enterprise's inter-enterprise interoperability strategy and achievements, covering years of IT development, the current interoperability requirements and the architecture of the solution: a message broker known as an Enterprise Application Infrastructure (eAI). The solution reduces ordering times by at least 50% and reduces the needed staff as well. 6) *Methods for the Analysis of Supply Network Processes at European SMEs* (Rabe) presented under R&D sessions as well (see above). 7) *The Accounting Information Sharing Model for Shanghai Grid* (Yu et al) the Grid is used as an information grid serving the public of the city of Shanghai. All resources are regarded as Grid Services in an Open Grid Services Architecture (OGSA). An accounting procedure based upon a computational economy model is solving the problem of resource allocation and charging in the grid multiple computer resource environments.

Particular Interoperability Solutions (3 papers)

1) *Impact of Moderation through the Distributed Virtual Enterprise Life Cycle* (Popplewell and Harding) explores the opportunity to apply intelligent, hybrid, knowledge based software Moderators to support and enhance collaboration throughout the product and virtual enterprise life cycle. 2) *Interoperability of Knowledge Based Engineering Software* (Kaufman and Claus) presents a systematic approach to capture design knowledge to be used in future applications as redesign or product lifecycle. Under the umbrella of the OMG Manufacturing Technology and Industrial Systems (ManTIS) Domain Task Force, a framework with a number of industry relevant specifications, PDM, CAD Services, Data Acquisition from Industrial Systems (DAIS & HDAIS), PLM Services, UMS Data Access Facility, and Distributed Simulation Systems have been adopted. 3) *The Federative Principle in Business Architecture* (Wagner and Schwarzenbacher), elaborates on the federative principle, which has proven successful as a behavioural pattern in natural organisms and communities. If accepted as strategic behaviour, the applications and IT structures themselves must be subject to this principle and designed federatively leading to a degree of interoperability.

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