I-ESA'10 Conference on Interoperability for Enterprise Software Applications, held in Coventry/UK, 2010-13/15.

Conference Summary

by

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Following a short presentation of the conference organization the conference summary concentrates on the technical content of the papers (except for Keynotes) presented at the conference. For the full papers see the conference proceedings *'Enterprise Interoperability IV – Making the Internet of the Future for the Future of Enterprise'*, Springer, ISBN 978-1-84996-256-8

The summary of the technical content of the conference is divided into two parts. A general overview of the technical content arranged according to technical aspects precedes the last section that provides a short summary of each paper. This section is arranged according to the conference program.

Proceedings Organisation

The proceedings are organized in seven parts addressing the major research in the scope of Interoperability for Enterprise Software and Applications:

I Business Interoperability

II Enterprise Modeling for Enterprise Interoperability

III Semantics for Enterprise Interoperability

IV Architectures and Frameworks for Interoperability

V Platforms for Enterprise Interoperability

VI Interoperability Scenarios and Case Studies

VII Standards for Interoperability

Paper summaries

1) Overall content of the conference

Part 1 of this summary organizes the theme of the papers according to their main subject (for summary of the referenced paper see part 2 of this section). Paper sequence is according to part 2 numbering and the Paper title (underlined) is repeated.

Interoperability – scientific base (1 paper)

Developing a Science Base for Enterprise Interoperability is an attempt to describe how this new interdisciplinary research area can be transformed into a vibrant scientific domain. Four relevant aspects of interoperability are identified (technical, semantic, organisational and enterprise/legal and policy related) *[23].*

Interoperability architecture (4 papers)

A UML-based System Integration Modeling Language for the Application System Design of Shipborne Combat System is based on a three-layer integration framework and an integration meta-model. *[9]*; GRAI-ICE Model Driven Interoperability Architecture for Developing Interoperable ESA (Enterprise Software Application) based on OMG/MDA defines five modelling levels: Top CIM, Bottom CIM, Object oriented PIM, Pattern oriented PSM, and component and configuration oriented CODE *[11];* An Interoperable Enterprise Architecture to Support Decentralized Collaborative Planning Processes in Supply Chain Networks supported by the Zachman architecture and REA ontology, considers a multi-agent based system approach. Applied in a real

automobile supply chain network *[20];* From Pipes-and-Filters to Workflows shows that the Pipes and Filters (PaF) architecture does not require an own implementation. It is sufficient to have a PaF- modelling tool and then convert the appropriate models to workflows for execution by an appropriate WfMS *[24].*

Model Languages (2 papers)

Alternative Process Notations for Mobile Information Systems is proposed allowing to identify origin and destination of information transfer needed in mobile information systems *[2]*; A Meta-model for a Language for Business Process Characterizing Modelling provides a foundation for building business process support systems (model still to be tested in case studies) *[7].*

Ontology (5 papers)

A Manufacturing Foundation Ontology for Product Life Cycle Interoperability will act as a basis for building Interoperable knowledge bases or 'World Models' for design and manufacture from a library of formally defined concepts in a heavy weight ontology *[14]*; An Ontology Proposal for Resilient Multi-plant Networks provides an initial ontological approach, intended to harmonize domain concepts and their relationships *[16]*; Collaboration Knowledge Ontologies to Support Knowledge Management and Sharing in Virtual Organisations classifies knowledge into three categories: enterprise, collaboration pool and VO knowledge according to the related organisation and represents it in an ontology to be used to structure a knowledge repository leading to a software service architecture that supports use and evolution of the knowledge base *[17]*; Gap Analysis of Ontology Mapping Tools and Techniques provides an analysis of mapping tools and techniques through a mismatches framework and shows that most of the tools and techniques target the explication side of the ontology concepts and very few opt for the conceptualization mismatches *[28]*; Specification of SETU with WSMO (Web Service Modelling Ontology; SETU = Dutch acronym for *Electronic Transactions within the Temporary Staffing Industry*). Using the hr-XML standard several UML class diagrams have been drafted. However, potential weaknesses and relevant questions regarding the applicability of WSMO have been identified *[32]*; Aligning the UEML Ontology with SUMO (Suggested Merged Upper Ontology) uses ontology mapping to preliminarily compare the two ontologies (UEML = Unified Enterprise Modelling Language) and makes suggestions for extensions and improvements for both *[38].*

Interoperability methods (2 papers)

A Success Story: Manufacturing Execution System Implementation describes project procedures of a successful implementation for manufacturing execution systems (MES). However, modularity and granularity of IT systems components and functions are still not sufficient for fast system implementation *[33]*; Enabling Proactive Behaviour of Future Project Managers explores the requirements and challenges to be addressed when implementing proactive project management in the industry *[34].*

Interoperability problems/requirements (3 papers)

Conceptual Framework for the Interoperability Requirements of Collaborative Planning Process that enables both characterization of the planning process in a supply network and identification of potential interoperability requirements *[3];* Contribution to Interoperability of Executive Information Systems Focusing on Data Storage System contains identification of different interoperability problems and a framework to position those problems and thereby help the designer to propose solutions. A formalism for the data storage element model based on the hub and spoke architecture has been developed *[10];* Towards a Conceptualisation of Interoperability Requirements defines interoperability needs of and required techniques and approaches for collaborating enterprises. Requirements are decomposed into three classes: compatibility-, interoperability- and reversibility requirements and two types: static and dynamic *[41.*

Interoperability analysis/testing (5 papers)

Towards Test Framework for Efficient and Reusable Global e-Business Test Beds addresses the core issues in traditional testing frameworks and the resulting inefficiencies and lack-of-reuse

problems *[5];* A Tool for Interoperability Analysis of Enterprise Architecture Models using Pi-OCL (Probabilistic imperative- Object Constraint Language) to query models for structural information (tool is still under development) *[8];* Model for Trans-sector Digital Interoperability based on an adapted ATHENA framework to enable modelling across different economic sectors allowing to take a full top-down approach (including business values) in the translation of business requirements into technological implementations *[12]*; How to Develop a Questionnaire in Order to Measure Interoperability Levels in Enterprises to measure the interoperability of an enterprise *[36]* Enterprise Collaboration Maturity Model (ECMM): Preliminary Definition and Future Challenges presents a process improvement approach conceived as a maturity model for collaborative networked organizations together with a roadmap and an improvement plan *[40].*

Interoperability solutions (4 papers)

Improving Interoperability using a UML Profile for Enterprise Modelling for models based on UEML and POP* *[4];* Unified Reversible Life Cycle for Future Interoperable Enterprise Distributed Information Systems to re-implement existing information systems employing distributed enterprise models from the conceptual level of the federated enterprise interoperability approach *[6]*; Transformation from a Collaborative Process to Multiple Interoperability Processes contains a method to align collaboration requirements with technology capabilities and to solve the interoperability problems of the enterprise by ranking the process according to the number of owners of activities and processes involved in the transactions. Future research needed *[13];* Collaboration Knowledge Management and Sharing Services to Support a Virtual Organisation analyses the requirements and investigates technical solutions for Partner Knowledge Management Services designed in compliance with the Service- Oriented Architecture and composed of reusable High- Low-Level Services in a hierarchy *[22].*

Interoperability applications (9 papers)

A Semantic Mediator for Data Integration in Autonomous Logistics Processes describes a concept of a technical architecture and a prototypical implementation of a semantic mediator. The concept has been validated *[15]*; Mediation Information System Engineering for Interoperability Support in Crisis Management proposes a crisis management cell with a set of tools based on an approach that is model driven using model morphisms principles and techniques *[18];* Business Cooperation-oriented Heterogeneous System Integration Framework and its Implementation presents an analysis of key technologies, such as ontology modelling, ontology mapping, and semantic interoperation mechanism and framework validation in a prototypical platform The proposed scheme provides an approach for heterogeneous system integration *[21];* Service-based Model for Enterprise Interoperability: Context-Driven Approach presents an approach to enterprise modelling that recognises the dynamics of the business environment and integrates service management to enable interoperability between Web services. Ontologies, context management and modern information technologies are used *[26];* Reflections on Aspects of Enterprise Interoperability investigates aspects of enterprise interoperability between small Internet Service Providers doing business in a virtual cluster. Cloud computing is recommended as a valuable perspective *[31];* Gaps to Fill Between Theoretical Interoperable Quality and Food Safety Environment and Enterprise Implementations analyses initiatives, standards and other solutions that are potentially relevant to achieve an interoperability environment model for the food chain companies *[35];* Knowledge Sharing and Communities of Practices for Intra-organizational Interoperability proposes a framework and some tools so that an intra-organizational interoperability capability emerges without "special efforts" *[37];* Emerging Interoperability Directions in Electronic Government describes the next steps needed to promote interoperability at technical, semantic, organizational, legal or policy level – leading to low-cost, high-quality services to citizens and businesses *[39].*

Model application (2 papers)

Service Value Meta-Model: An Engineering Viewpoint allows for comprehensive description of service value leading to a multi-level service value model *[19]*; Transformation of UML Activity Diagram to YAWL, a formal workflow language, has been developed leading to significant benefits in user understanding, simplification and verification *[27].*

Applications in VOs (3 papers)

Ad-hoc Execution of Collaboration Patterns using Dynamic Orchestration allows to encapsulate reusable frames of collaboration activities and to execute those using the re-configurable Maestro BPEL workflow engine *[1]*; Risk Sources Identification in Virtual Organisation provides a comprehensive literature study that identified thirteen risk sources. Overall recommendation: improved, risk aware decision making reduces the costs of wrong decisions, and failed collaborations *[25]*; Opportunity Discovery Through Network Analysis presents a formalization of the process of discovering opportunities in a network of research organizations *[30]*.

New platform (1 paper)

Networked Enterprise Transformation and Resource Management in Future Internet Enabled Innovation Clouds is a software platform for a new innovation driven ecology for networked enterprises. It is extended on top of an established cloud-based, Software-as-a-Service business operation platform and combined with an advanced innovation management software platform. Concepts planned to be implemented *[29]*.

Interoperation standards (1 paper)

Use Profile Management for Standard Conformant Customisation analyses obstacles and hampering factors in the adoption of public standards to improve e-Business in SME networks as well as the experience of promoting such standards. Some of the actions can be pursued through the adoption of use profiles that allow to not only horizontal specifications, but vertical ones as well *[42]*.

2) Paper content

The following pages provide short summaries of the conference papers presented in the different parts of the conference proceedings:

Part I Business Interoperability (6 papers)
[1] Ad-hoc Execution of Collaboration Patterns using Dynamic Orchestration; *Jean-Pierre Lorre et al* present the use of Collaboration Patterns (CPats) in virtual organizations that are executed in an ad hoc way. Such patterns encapsulate reusable frames of collaboration activities. The authors propose a schema that combines the initiatives of CPats along with a dynamic service orchestration engine based on an autonomic framework called Fractal. Emphasis is on the Maestro BPEL ad-hoc workflow engine that enables reconfiguration of running process. Such approach allows reorganizing service workflow at run-time in order to take into account collaboration network plasticity. **Keywords:** Collaboration pattern, SOA, dynamic service orchestration, BPEL
[2] Alternative Process Notations for Mobile Information Systems; *Sundar Gopalakrishnan and Guttorm Sindre* discuss the specific needs of mobile information systems; especially the 'Where' (origin and destination of information transfer) of services to be involved. Notations used in current modelling languages do not really address the modelling needs in mobile domain. In particular, the location and context of an information processing activity is less fixed than that of a desktop-based system. The paper explores some alternative notation variants for UML activity diagrams to address these needs. Some notations are proposed and compared, using a case study from the home care domain. **Keywords:** Requirements specifications, model-based, UML, use case diagrams, BPMN
[3] Conceptual Framework for the Interoperability Requirements of Collaborative Planning Process; *María M.E. Alemany et al,* present a conceptual framework for the simultaneous characterization of the collaborative planning process in a supply network and the identification of potential interoperability requirements. The latter can be used as a first step for measuring interoperability through maturity models and other models and determining the impact of the interoperability investments on the business. This early requirement identification can help to define the interoperability problem space that is essential for the solution space definition, thus saving

subsequent costs and efforts.
Keywords: collaborative planning process, supply networks, conceptual framework, interoperability requirements.

[4] Improving Interoperability using a UML Profile for Enterprise Modelling; *Reyes Grangel et al,* present a framework that can be used to model enterprise dimensions, at the same time making it much easier to achieve interoperability between resulting models based on UEML and POP*. The framework itself is based on UML using UML Profiles, and on the existing enterprise modelling meta-models proposed to solve interoperability problems. The paper provides a general description of the framework, as well as a detailed explanation of the UML Profile that was developed to represent one of the enterprise dimensions that can be modelled with the framework: the organisational structure.
Keywords: Interoperability, Enterprise Modelling, Enterprise Modelling Language, UML, UML Profile, Organisational Structure.

[5] Towards Test Framework for Efficient and Reusable Global e-Business Test Beds; *Nenad Ivezic et al,* introduce a novel Agile Test Framework for eBusiness systems interoperability and conformance testing. It addresses the core issues found in traditional testing frameworks to alleviate the resulting inefficiencies and lack-of-reuse problems that arise in the development of e-Business test beds.
Keywords: testing, e-Business, interoperability, conformance, test framework, test bed, reusability.

[6] Unified Reversible Life Cycle for Future Interoperable Enterprise Distributed Information Systems; *Zhiying Tu et al,* aim at improving the re-implementation of existing information systems to be involved in a system of systems, i.e. a federation of interoperating enterprise information systems. The idea is to reuse the local experiences coming from the development of the original information system with the process of model discovery and an ontological approach. The authors postulates a MDA/HLA lifecycle to implement distributed enterprise models from the conceptual level of the federated enterprise interoperability approach. In addition a model reversal methodology is proposed to help re-implement the legacy information system, in order to achieve the interoperability with other systems.
Keywords: Interoperability, HLA, MDA, FEDEP, Information System.

Part II Enterprise Modeling for Enterprise Interoperability (6 papers)

[7] A Meta-model for a Language for Business Process Characterizing Modelling; *Shang Gao and John Krogstie* define a meta-model for the business process characterizing model (BPCM), that mainly captures the syntax and semantics of the BPCM itself. The meta-model, is intended to guide the development of business process support systems. In addition, the relation between the SCOR model and the class process in the BPCM meta-model and the mapping from the BPCM meta-model to the BPMN meta-model in a combined framework for developing business process support systems are addressed. However, the BPCM meta-model has not yet been tested in any case studies.
Keywords: Meta-model, Business Process Characterizing Model (BPCM), Process Modelling, SCOR.

[8] A Tool for Interoperability Analysis of Enterprise Architecture Models using Pi- OCL; *Johan Ullberg et al,* present a software tool, currently under development, for interoperability analysis of enterprise architecture models. Main focus is on the ability to query models for structural information. Both the tool architecture and its usage are described and exemplified.
Keywords: Enterprise Architecture, Probabilistic Relational Models, Software tool, Interoperability.

[9] A UML-based System Integration Modeling Language for the Application System Design of Shipborne Combat System; *Fan Zhiqiang et al* developed an integration model for a distributed application systems, that needs to interoperate. The paper discuses i) the three layer, integration framework of application systems of Shipborne Combat System (SCS): data, function and workflow, ii) integration meta-model based on the framework and iii) detailed explanation of the SCS data, application system, function, component, workflow and their relationships. A system integration modeling language for application system design (SIML4ASD) based on the

metamodel is defined by extending UML using profile mechanism.
Keywords: integration framework; integration meta-model; SIML4ASD; UML.

[10] Contribution to Interoperability of Executive Information Systems Focusing on Data Storage System *Guillaume Vicien et al,* identify in their work the different interoperability problems that can occur during the design of the data storage system of an executive information system. Positioning those problems an interoperability framework, the designers can identify and propose solutions. The authors propose a framework for the design and implementation of data storage systems and analyse and compare different possible architectures.
Keywords: executive information system, performance indicators, interoperability.

[11] GRAI-ICE Model Driven Interoperability Architecture for Developing Interoperable ESA ;*Lanshun Nie etal* present the GRAI-ICE Model Driven Interoperability Architecture (MDI) that is developed based on MDA of OMG and some initial work performed in INTEROP NoE. This MDI architecture aims at supporting the development of changeable on-demand and interoperable ESA (Enterprise Software Application). The architecture defines five modelling levels: Top CIM, Bottom CIM, Object oriented PIM, Pattern oriented PSM, and Component and configuration oriented CODE. The paper presents in detail core concepts and rational of each modelling level. An application example in nuclear equipment industry is outlined.
Keywords: MDI, MDA, ESA, Interoperability, Architecture, Model transformation.

[12] Model for Trans-sector Digital Interoperability *António Madureiraet al,* propose a novel model to address *trans-sector digital interoperability*, which by definition involves interoperability across different economic sectors connected by Digital Information Networks. The authors specify how the ATHENA framework should be adapted and taken from the enterprise plane to the economic sector plane. Based on data from the Eurostat survey on ICT usage and e-Commerce in enterprises, conclusions about trans-sector interoperability can be extracted and technological implications can be derived.
Keywords: interoperability; MDA; sector; economic; model; productivity; service science; ATHENA; digital information network.

Part III Semantics for Enterprise Interoperability (6 papers)

[13] Transformation from a Collaborative Process to Multiple Interoperability Processes; *Hui Liu and Jean-Pierre Bourey* propose a method to align collaboration requirements with technology capabilities and to solve the interoperability problem of the enterprise. The authors define some important concepts in the domain of enterprise interoperability like "rank of interoperability process" that makes it possible to analyse the relationships between three kinds of interoperability processes. The paper elaborates in detail on the transformation from collaborative to interoperable processes.
Keywords: collaborative process, interoperability process, transformation, rank of interoperability process.

[14] A Manufacturing Foundation Ontology for Product Life Cycle Interoperability; *Zahid Usman et al* propose an Manufacturing Foundation Ontology (MFO) aimed at acting as a basis for the Product Life Cycle interoperability. MFO has the provision for introducing interoperability not only across departments but across whole organization as well. The proposal shows the development of a MFO in several layers and various levels in those layers. The foundation ontology will act as a basis for building Interoperable knowledge bases or 'World Models' from a library of formally defined concepts in a heavy weight ontology. MFO must be flexible enough to allow organizations to be able to model their own domains with the flexibility to use the terms they want. Rules and axioms governing each and every concept add rigour to the semantics of the MFO and restrict the use of concepts to facilitate interoperability with a minimum effect on flexibility to model.
Keywords: Business Interoperability requirements, meta-modelling for Interoperability, foundation Ontology, semantic mediation and enrichment, Product Life Cycle Interoperability.

[15] A Semantic Mediator for Data Integration in Autonomous Logistics Processes; *Karl Hribernik et al* investigate the applicability of the semantic mediator concept in data integration problems arising from an application scenario of autonomous control in the transport logistics sector. An application scenario exemplifying autonomous control in the field of transport logistics is

presented and analysed. Based on the analysis a concept of a technical architecture and a prototypical implementation of a semantic mediator is developed and described. A critical appraisal of the semantic mediator in the context of autonomous logistics processes concludes the paper.
Keywords: semantic mediator, semantics, ontologies, data integration, autonomous logistics processes.

[16] An Ontology Proposal for Resilient Multi-plant Networks; *Rubén Darío Franco et al,* present an ontology proposal for the REMPLANET FP7 project that aims at developing methods, guidelines and tools for the implementation of Resilient Multi-Plant Networks in non-hierarchical manufacturing networks, characterized by non-centralized decision making. Due to structural heterogeneity of the REMPLANET integration scenarios, an ontological approach seems to be a first key challenge to be addressed. Consequently, one of the main contributions of this paper is to provide an initial ontological approach, intended to harmonize domain concepts and their relationships.
Keywords: Ontology engineering, Resilient multi-plant networks, Interoperability.

[17] Collaboration Knowledge Ontologies to Support Knowledge Management and Sharing in Virtual Organisations; *Muqi Wulan etal* focus on representing collaboration knowledge in the context of the Virtual Organisation (VO) life cycle that embodies the VO characteristics from incubation to termination. The classification of collaboration knowledge or knowledge repositories is described in terms of 3 different types of organisations: individual enterprises, collaboration pools and VOs. Accordingly, collaboration knowledge falls into three main categories: enterprise knowledge, collaboration pool knowledge and VO knowledge. Later they are elucidated in an ontology that can be used to structure a knowledge repository leading to a software service architecture that supports population, application and evolution of the knowledge base The terms and concepts are defined and considered to be consistent with each other.
Keywords: knowledge management, knowledge sharing, ontology, collaboration, VO.

[18] Mediation Information System Engineering for Interoperability Support in Crisis Management*; Sébastien Truptil et al* report on work carried out in the French-funded project on Interoperability of Systems in Crisis situation set out to provide the crisis management cell in charge of the situation management within an information system able to support the interoperability of partners involved in this collaborative situation. The authors propose an approach of MIS engineering in crisis context that is model-driven and uses model morphisms principles and techniques implemented in a set of tools. Furthermore, due to the intrinsically evolutionary nature of crisis phenomenon, the MIS must remain adapted to the situation and to the panel of partners involved. The paper presents also the MIS on the fly adaptation in order to provide agility to the MIS.
Keywords: Information System, Interoperability, Mediation, Ontology, Crisis, Model driven engineering.

[19] Service Value Meta-Model: An Engineering Viewpoint; *Zhongjie Wang et al* propose a service value meta-model that allows for comprehensive description of service value from an engineering point of view The authors have analysed service value modelling extensively and present the various essential aspects of service value that have significance for service system design. Each aspect is illustrated in detail by a set of concepts. Based on the service value meta-model, a multi-level service value model and the corresponding value-oriented service engineering process are briefly introduced.
Keywords: service engineering, service modeling, service value, meta-model, value-aware.

Part IV Architectures and Frameworks for interoperability (8 papers)

[20] An Interoperable Enterprise Architecture to Support Decentralized Collaborative Planning Processes in Supply Chain Networks; *Jorge E. Hernández et al* propose an novel interoperable enterprise architecture to support the decentralized collaborative planning and the decision-making processes in supply chains. In addition, the proposed architecture, supported by the Zachman framework and by the REA standard ontology, considers a multi-agent based system approach as well as its application to a real automobile supply chain network.
Keywords: Enterprise architecture, Interoperability, Multi-Agent, Collaborative planning.

[21] Business Cooperation-oriented Heterogeneous System Integration Framework and its

Implementation; *Yihua Ni et al* propose a framework for business cooperation-oriented integration of heterogeneous system. The authors analysed key technologies related to the framework, such as ontology modelling, ontology mapping, and semantic interoperation mechanism. As a proof of concept, a prototypical platform based on this framework was developed and the operating principle of the platform has been analysed. The proposed scheme has great theoretical significance, since it provides a new architecture and an approach for heterogeneous system integration. **Keywords:** ontology, business cooperation, heterogeneous system, ontology integration.
[22] Collaboration Knowledge Management and Sharing Services to Support a Virtual Organisation; *Muqi Wulan et al* analysed the requirements of knowledge management for collaboration in a virtual organisation and investigated technical solutions for Partner Knowledge Management Services (PKMS): web services that provide knowledge sharing and protection within such collaborations. PKMS is designed in compliance with the Service- Oriented Architecture and composed of High- Level Services and Low-Level Services in a hierarchy, which assure that services can be reused and contribute to adaptive and flexible business applications. The functions and relationships of High-Level Services and Low-Level Services are presented. The architecture of PKMS can be implemented through four structural layers: presentation, business logic, middleware and persistence. **Keywords:** knowledge management, knowledge sharing, collaboration, VO, web services.
[23] Developing a Science Base for Enterprise Interoperability; *Yannis Charalabidis etal* present the ingredients of this new domain, propose its needed formal and systematic tools, explore its relation with neighbouring scientific domains and finally prescribe the next steps for achieving the thrilling goal of laying the foundations of a new science. The authors attempt to describe how this new interdisciplinary research area can transform into a vibrant scientific domain, by applying the necessary method and tools. Four relevant aspects of interoperability are identified (technical, semantic, organisational and enterprise/legal and policy related). **Keywords:** Enterprise Interoperability, Scientific Foundation, Formal Methods.
[24] From Pipes-and-Filters to Workflows*; Thorsten Scheibler et al* show that the *Pipes-and-Filters (PaF)* Architecture that is successfully exploited in the context of *Enterprise Application Integration (EAI)* using specialized EAI-vendor technology can be used very effectively in Workflow applications as well. The EAI implementation approach is in conflict with flow technology, a cornerstone of the *Service-Oriented Architecture (SOA)*. The authors resolve this conflict by implementing the PaF architecture using flow technology and transforming the relevant PaF- patterns, into appropriate WS-BPEL constructs. The results of appropriate tests show that the performance of the corresponding workflows is superior to the mapping of PaF-patterns to message flows. The authors show that the PaF architecture does not require an own implementation. It is sufficient to have a PaF- modelling tool and then convert the appropriate models to workflows for execution by an appropriate WfMS. **Keywords:** Enterprise Application Integration, BPEL, Pipes-and-Filters, Workflows.
[25] Risk Sources Identification in Virtual Organisation; *Mohammad Alawamleh and Keith Popplewell* provide a comprehensive literature study on network related risks in VOs identifying thirteen risk sources like lack of trust, top management commitment, information sharing, others. To gain a better understanding the authors have gone through these threats one by one using literature and previous studies, then evaluating and ranking these sources based on qualitative study. Overall recommendation: improved, risk aware decision making reduces the costs of wrong decisions, and failed collaborations. **Keywords:** virtual organization; VO, risk, risk identification, SME.
[26] Service-based Model for Enterprise Interoperability: Context-Driven Approach; *Alexander Smirnov et al* present an approach to enterprise modelling, based on integration of efficient service management, for enabling interoperability between Web services in an open information environment. Ontology, context management and modern information technologies are used. The latter make it possible to develop new approaches to enterprise modelling, allowing to take into account the dynamic nature of the business environment. Application of constraints for knowledge representation makes it possible to integrate with existing services as well as to propose a scenario

for self-organization of services for problem solving.
Keywords: enterprise modelling, ontology, context, information service, Web-service.

[27] Transformation of UML Activity Diagram to YAWL; *Zhaogang Han et al* define a transformation from UML 2.0 Activity diagram (UML-AD) to YAWL, a formal workflow language that is able to capture all of the 20 workflow patterns. The authors illustrate the transformation challenges and present a suitable transformation algorithm. The benefit of the transformation is threefold: i) clarified UML-AD semantics, ii) simplified deployment of UML-AD business process models as workflows and III) verified UML-AD models with YAWL tools.
Keywords: Business Process Modeling, Workflow, UML, Activity Diagram, YAWL.

Part V Platforms for Enterprise Interoperability (5 papers)

[28] Gap Analysis of Ontology Mapping Tools and Techniques; *Najam Anjum et al* present results from their state of the art analysis. Mapping between ontologies provides a way to overcome any dissimilarities in the terminologies used in different applications. Some tools and techniques to map ontologies are available with some semi-automatic mapping capabilities. These tools are employed to join similar concepts in two ontologies and to overcome the possible mismatches. Several types of mismatches have been identified by researchers and certain overlaps can easily be seen in their description. Analysis of mapping tools and techniques through a mismatches framework reveals that most of the tools and techniques just target the explication side of the concepts in ontologies and very few of them opt for the conceptualization mismatches. Research therefore needs to be done in the area of detecting and overcoming conceptualization mismatches that may occur during process of mapping.
Keywords: Ontology Mapping, Ontology Mismatches, Ontology Mapping Tools and Techniques.

[29] Networked Enterprise Transformation and Resource Management in Future Internet Enabled Innovation Clouds*; Brian Elvesæter et al* present the NEFFICS platform, which is a software platform as a basis for a new innovation driven ecology for networked enterprises. It is extended on top of an established cloud-based, Software-as-a-Service business operation platform and combined with an advanced innovation management software platform. The business context and value of the new platform will be demonstrated and validated in enterprise communities in two major European industrial sectors, through optimising their operational performance and innovation capacity. Open Business Model Innovation and process/service/product innovation will be managed and measured to demonstrate value generation at the business level.
Keywords: cloud, software-as-a-service, business operation platform, open innovation.

[30] Opportunity Discovery Through Network Analysis; *Alessandro Cucchiarelli and Fulvio D'Antonio* present a formalization of the process of discovering opportunities in a network of research organizations. The authors introduce *opportunity networks* constituted by a *network* modelled as a directed attributed multigraph, an *opportunity exploiter*, a set of *opportunity patterns* and *opportunity ranking functions*. They show how the discovery of joint-research collaborations opportunities in a research-oriented network can be formulated in terms of the proposed formalism.
Keywords: Social network analysis, data mining, graph transformations, recommendation systems.

[31] Reflections on Aspects of Enterprise Interoperability; *Jane Hall and Klaus-Peter Eckert* report on the European research project VISP that investigated various aspects of enterprise interoperability between small Internet Service Providers (ISPs) doing business in a virtual cluster. The paper provides an overview of the project work, discusses the points considered and what is still required to ensure seamless and reliable interoperability between small ISPs doing business in a cluster. A perspective relating the work in VISP to cloud computing concludes the paper.
Keywords: enterprise interoperability, workflow, ISPs, services, cloud computing.

[32] Specification of SETU with WSMO; *Wout Hofman et al* show the relevance of applying a more formal specification approach like the Web Service Modelling Ontology (WSMO) to SETU (Dutch acronym for *Electronic Transactions within the Temporary Staffing Industry*), an organisation that operates a major interoperability project concerning temporary staffing of personnel for different application areas.

The hr-XML (www.hr-xml.org) standard is applied to the Dutch situation. Several UML class

diagrams representing different information streams have been drafted as the basis for these Dutch standards. By applying WSMO to a case, we also identify potential weaknesses and/or relevant questions regarding the applicability of WSMO.
Keywords: case study, formal specification, web services, hr-XML.

Part VI Interoperability Scenarios and Case Studies (5 papers)

[33] A Success Story: Manufacturing Execution System Implementation; *Albin Bajric et al* describe project procedures of a successful implementation for manufacturing execution systems on a real case. It illustrates interoperability barriers arisen during the project and how they are handled. The focus is on aspects of arising issues of organisational interoperability between IT-vendor and its customer (the user). An enterprise model was used as the major tool for the description of the processes and the communication between user and IT vendor. This enterprise model has also guided the implementation of the IT system.

However the approach illustrates a lack of modularity and granularity of the components and functions of IT-systems. This hinders a fast derivation of a system implementation from enterprise models as well as customer satisfaction and cost efficient realisation of the running systems in an enterprise. Further actions are necessary to realise real service oriented and reliable systems available on the commercial market which can be flexible adapted to business and operational process demands. Even when such concepts exists in the research area the commercial availability is low or at least to expensive.
Keywords: MES, Interoperability, system implementation, manufacturing management, enterprise model.

[34] Enabling Proactive Behaviour of Future Project Managers; *Georgios Kapogiannis et al* explore the requirements and challenges to be addressed when implementing proactive project management in the industry. It describes the current challenges of project management and explains how self-oriented, anticipatory and initiation behaviours that form proactive behaviours could increase the success rates of projects in the future.
Keywords: project management, organisation, proactive behaviour, collaboration.

[35] Gaps to Fill Between Theoretical Interoperable Quality and Food Safety Environment and Enterprise Implementations; *David Martínez-Simarro et al* analyse initiatives, standards and other solutions that potentially can cover food chain traceability, food safety and quality management needs and determine existing gaps to fill to achieve an interoperability environment model for the food chain. Most of current quality and food safety information systems in the industry do not fill the special needs of the food companies. The need for effective risk assessment and communication is becoming increasingly recognized by many governments and the food industry as well. Although risk communication of food safety issues is still in its infancy, much can be learned from past experience.
Keywords. Interoperability, Standards, Supply chain, Food safety, Risk, Contamination, Food quality; Nutrition; Food chain; Consumer.

[36] How to Develop a Questionnaire in Order to Measure Interoperability Levels in Enterprises; *Noelia Palomares et al* show how to develop an evaluation method by means of a questionnaire that allows the interoperability of an enterprise to be measured. The application of the questionnaire will serve to determine the level of interoperability achieved by the enterprise and to detect the aspects to be improved. Using an application example, the paper describes the development of such a questionnaire by defining the tasks and steps to be followed.
Keywords: Interoperability, Enterprise Interoperability, Maturity Model, Questionnaire.

[37] Knowledge Sharing and Communities of Practices for Intra-organizational Interoperability; *Philippe Rauffet et al* discuss the use of knowledge sharing and communities of practices so as to make possible and support collaboration between units inside the same organization. It proposes a framework and some tools so that an intra-organizational interoperability capability emerges without "special efforts".
Keywords: organizational interoperability, Communities of practices, transfer of good practices.

Part VII Standards for Interoperability (6 papers)

[38] Aligning the UEML Ontology with SUMO; *Andreas L. Opdahl* uses ontology mapping to

preliminarily compare the Unified Enterprise Modelling Language (UEML) ontology with the Suggested Merged Upper Ontology (SUMO). In addition to suggesting extensions of and improvements to both ontologies, the comparison paves the way for an eventual inclusion of the UEML ontology into SUMO or into one of its successors. The procedure used to compare and map the two ontologies is another contribution of the paper. The comparison indicates that, although central concepts in the two ontologies match one another well, considerable effort will be required to include the UEML ontology into SUMO as a mid-level ontology.

UEML itself provides a hub for integrated use of the many different modelling languages available for representing enterprises and their information systems. UEML centres around a common ontology that interrelates the semantics of existing modelling languages and their constructs.

Keywords: Ontology, Bunge-Wand-Weber model, BWW model, Unified Enterprise Modelling Language, UEML, Suggested Upper Merged Ontology (SUMO), ontology alignment, ontology engineering, enterprise modelling, information systems modelling, interoperability.

[39] Emerging Interoperability Directions in Electronic Government; *Yannis Charalabidis et al* present the main milestones in the quest of public sector administrations for open, collaborative, loosely coupled systems and components that have shaped electronic government during the last years, describing national frameworks, key pan- European projects, international standardization and main industrial and research achievements in the EU. Moreover, the paper describes the next steps needed to promote interoperability at technical, semantic, organizational, legal or policy level – leading to the transformation of administrative processes and the provision of low-cost, high-quality services to citizens and businesses.

Keywords: e-Government interoperability, interoperability standards, state of the art.

[40] Enterprise Collaboration Maturity Model (ECMM): Preliminary Definition and Future Challenges; *Juncal Alonso et al* present a process improvement approach conceived as a maturity model (developed in the European COIN project) for collaborative networked organizations, in which organizations participating in a network are assessed, both as a stand-alone company and with respect to the network. The result of this assessment will provide the organization with a picture of where they are at that moment and where they have to be if the maturity model is fully respected. Additionally a roadmap and an improvement plan is suggested that will help the company fill the gap.

Keywords: Enterprise Collaboration, Enterprise Interoperability, Maturity Models, Networked Environments, Readiness Assessment.

[41] Towards a Conceptualisation of Interoperability Requirements; *Sihem Mallek et al* focus on the particular interoperability needs of and required techniques and approaches for collaborating enterprises and describe an approach to define and to formalise those needs into interoperability requirements. These requirements are decomposed on three classes: compatibility, interoperability and reversibility requirements and two types: static and dynamic. Finally, verification techniques can be used to detect how and where some of these requirements cannot be satisfied and thereby highlighting interoperability problems.

Keywords: Interoperability requirements, compatibility, interoperation, reversibility, verification, enterprise.

[42] Use Profile Management for Standard Conformant Customisation; *Arianna Brutti et al* address adoption of public standards to improve e-Business, especially among networks of SMEs. However, the adoption of such specifications encounters obstacles and hampering factors. The authors analyse some of those factors as well as the experience of promoting the adoption of standards for e-Business in sectors dominated by SME's presence and outline some of the actions that can be pursued through the adoption of use profiles that allow to not only horizontal specifications, but vertical ones as well.

The paper also present an approach for the management of use profiles, that appear as a way to overcome some of the major problems arising from the nature of the standardised specifications and to reduce the efforts necessary to achieve true interoperability between systems.

Keywords: interoperability, UBL, standard, use profile, eBusiness, co-constraints, SMEs.