

INTEROPERABILITY + SEMANTICS = CHECK!

Smart and Cost Effective Data Modelling and Tools of the Future

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1. SUMMARY

The more we rely on digitalisation in our transaction and businesses, the more we need to ensure that machine to machine communication can take place at high speed. Still, interoperability of information systems and the lack of shared semantics, both between humans and machines, is an internationally recognised issue. Information systems in the Finnish higher education sector, in the field where decentralisation of information systems is preferred, are not an exception. Semantic interoperability will enable higher education institutions wide cost benefits in relation of 1:38 at the national level.

In Finland we are in the process of implementing information systems and harmonising the legacy data models in the way that makes use of the shared semantics, standards and other best practices according to the common architectural vision. This basic infrastructure for information management is built by combining terminological theory, linked data and adaptable data modelling practices.

2. SMART AND COST EFFECTIVE DATA MODELLING AND TOOLS OF THE FUTURE

When you "talk the talk" you need to "walk the walk" it's a common phrase you hear. The new approach we have to data management and interoperability is a mix of some existing elements with previously untapped potential, e.g. use of semantic technologies and linked data in the Finnish higher education sector. It forms a structured, common architecture frame connecting conceptual modelling of business, services and processes to defining and maintaining controlled terminology and further to constructing data models for information systems.

Many efforts have been made trying to define best practices and guidelines for interoperability; one of the most effective being RAKETTI-project (*Information Services as Part of the HEIs' Structural Reform*) during the years 2008-2014. The results, however, support mainly data storage, data collection and reporting activities based on a strictly normalised data model. Typically architecture of higher education information systems is based on traditional databases which have their own data models and terminology and moving the data from one information system to another requires high cost expert labor work.

The modelling process of any information system should start from conceptual modelling. What is usually missed at this stage is a systematic and formalised method for concept defining. It is not that we do not have them, it is that we have not fully recognised the value of humanistic terminological theory (ISO, 2009). We argue that the concepts we use in business and operations of agencies (e.g. *Vocabulary of Education*, (OKSA, 2016), typically in cross-human communication situations, should form the solid foundation also for semantics of data models used in information systems. The controlled, methodologically intact terminology should be openly available both in human and machine

readable formats, such as SKOS (W3C, 2012). In Finland, SKOS vocabularies will be published in the *Finnish Ontology Service* (FINTO, 2016), maintained by the Finnish National Library.

Terminology work takes no role in defining logical data structures, such as classes, properties and part-of relations. For this purpose a so called *Semantic Interoperability Model* is needed. It connects the concepts and logical data models together and pass the shared semantics to every implementation that re-uses its components (Figure 1). The Semantic Interoperability Model, actually a linked data vocabulary, identifies the re-usable information components with URIs (Uniform Resource Identifiers), and enables creation of *application profiles* for specific use cases. Application profiles are data models constructed and documented in human and machine-readable formats following the guidelines from DCMI (DCMI, 2009) and rethinking the metadata specifications developed by CEN (CEN/TC 353). These profiles re-use the descriptions and mappings and make it possible to transform the re-usable components into different standard technical formats, such as XML or JSON schemas.

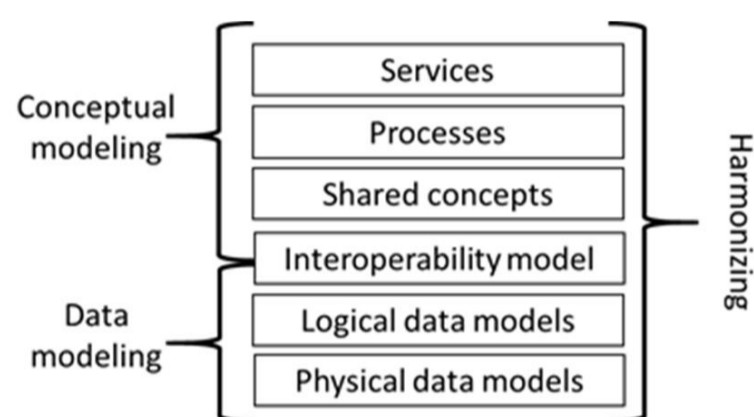


Figure 1. Common architecture frame connecting conceptual and physical modelling.

One of the goals of our work has been to build a prototype for collaborative online tool for creating linked data vocabularies and application profiles – instead of documenting terminology and data model descriptions, as usual, in e.g. separate wiki pages or spreadsheet. This work has proceeded and we are proud to present the solution: *IOW - Interoperability Workbench* (CSC, 2016). It is an open source IT software and as a modular implementation it enables further development, as linkages e.g. to existing Code Services.

The Semantic Interoperability Model and IOW is being developed by the Ministry of Education and Culture for supporting the needs of institutions of higher education and research, but the work will in future form the basis for a wider *National Metadata Service* and be a part of the *National Service Architecture* (Ministry of Finance, 2015). We argue that this approach to interoperability and semantics of information and digital services has potential also in the context of international cooperation.

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AUTHORS' BIOGRAPHIES



Suvi Remes is working as specialist in information management and semantic interoperability at CSC - IT Center for Science and has experience in developing information and data management and architecture on different levels of abstraction and operations.

She leads as project manager the service development of *IOW - Interoperability Workbench* and coordinates its introduction and implementation in the field of higher education and research but also on a national level together with strategic co-operation partners. She is a member of the Ministry of Education and Culture led working group for *Vocabulary of Education*, and co-coordinates the language translations for the terminology. She is also a member of a national-level terminology working group which guides and develops the terminology work and its processes for the public sector in Finland.

Suvi is also working for the *Open Science and Research Initiative (ATT)* which the Finnish Ministry of Education and Culture set out to promote research information accessibility and open science. Suvi chairs the *ATT Metadata Working Group* which has studied possibilities to improve interoperability, especially semantic interoperability, in metadata management focusing on research data and datasets. She also, from time to time, coaches the research administration terminology working group. She has experience in working in various international networks, including standardisation work both in the national and the international bodies, e.g. CEN and ISO.

Suvi holds a M.Sc. in Cultural Geography and she has since deepened her understanding of semantic theories studying further Linguistics and Literature. Her interest lies in the terminological theory and its applications in information management and different communication situations.

Previously Suvi has worked few years in a private sector company in industry coordinating and developing information management processes. She has also work experience from study administration, focused that time on international student mobility and admissions.



Miika Alonen is working as interoperability architect and specialist in semantic interoperability at CSC - IT Center for Science. He is the chief architect and also active developer in the service development of *IOW - Interoperability Workbench* and participates in various national networks in the implementation process of this new architecture approach.

Miika has a strong IT background and experience in projects focusing in semantic interoperability. He holds a M.Sc. in Software Engineering and is currently, on the side of his full time job, doing his postgraduate studies at Aalto University in the field of Semantic Computing.

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Patrik Maltusch is heading the EA architecture team at Aalto University. He is also acting member and chairman of the Finnish National Enterprise Architecture Special Interest Group and one of the lead educators who have coached administration staff in the national wide Higher Education EA schooling program. Past experience include working as a customer service instructor for nearly ten years and further fifteen years as network architect and business owner for internal infrastructure design in a global Telco company. Patrik is also a distinguished and accredited security professional, risk manager, system auditor and a certified Higher Education Enterprise Architect. As entrepreneur and start up facilitator Patrik understands what staying practical means for business. For

Patrik interoperability is the key to success in an ever growing and more complex and complicated ecosystem landscape. Something that can be achieved using EA methodology in a more visualized way.

Experience per domain:

Software Security 5+ years, Hotel & Restaurant 10+ years, Information Security 10+ years, ICT Service Management 15+ years, Project Management 15+ years, Business Management 15+ years, ICT Networks 20+ years, IT Systems 30+ years.

LinkedIn profile:

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Publications:

Maltusch, Patrik & Nieminen, Virpi (2015). *Business and Dynamic Change: The Arrival of Business Architecture. Applying Architecture to Business Transformation and Decision-making: Case Aalto University*. Future Strategies Inc. <http://futstrat.com/books/BusinessandDynamicChange.php>

Mikael af Hällström works as senior advisor at Finnish Tax Administration. He has been working in different cross-governmental projects since the mid-2000s, mainly focusing on developing interoperability, including national controlled terminologies and vocabularies, information architecture modeling frameworks, nationally harmonised code lists and classifications and XML schema conformance. Mikael chairs several national level working groups with connection to these themes and he is also a member of steering groups directing development of procedures and actions on interoperability in the public sector in Finland. He holds a Master's degree in Law.