Model-driven Semantic Interoperability using Open Standards: A Case Study

New Zealand Education Sector Architecture Framework (ESAF)

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Document Title: Model-driven Semantic Interoperability using Open Standards: A Case Study

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Document Overview

Purpose

This document describes a case study of the New Zealand Education Sector's semantic interoperability.

The document serves as a basis for drawing conclusions in similar situations in other sectors and industries.

Scope

This document focuses on defining, sharing and implementing the meaning of shared data, also known as semantic interoperability. The scope is kept at a high level, and gives an insight into the Education Sector's:

- Background
- Business considerations
- Key issues
- Selected solution
- Benefits
- Lessons learnt

Other facets of interoperability are not in scope of this case study.

Audience

Anyone, in any sector or industry, with an interest in interoperability of computer systems:

- Business Managers
- Strategic Business Users
- IT Managers
- IT Technical Staff

References

OASIS UBL NDR: http://www.oasis-open.org/specs/index.php#ublv2.0

Wikipedia: http://en.wikipedia.org/wiki/Interoperability

Paul Miller: http://www.ariadne.ac.uk/issue24/interoperability/intro.html

Executive Summary

Background

Sharing data, and thus making systems interoperable, is becoming more important.

At present, point-to-point data exchanges are common, while organisations are increasingly struggling to sustain the ever-growing number of such non-standardised data exchanges fraught with misunderstandings, processing errors and data quality issues.

Interoperability is not simple, and has many facets and thus definitions. The facet in focus of this New Zealand Education Sector case study is semantic interoperability, which is achieved when:

- Data exchange partners have a shared understanding of the meaning of shared data
- Data exchanges adhere to the shared understanding
- Data is exchanged without misinterpretations

The case study and described solution are applicable to other sectors and industries in similar situations.

Business considerations

The New Zealand Education Sector consists of various organisations, some of which are listed on the title page. While these organisations run their IT systems autonomously to fulfil their purpose, they also collaborate and share a considerable amount of information to make the Education Sector function as a whole.

The Sector's stated objective for semantic interoperability is:

"To produce a sector data model that defines shared sector data so that sector participants can provide, manage, access and understand the data."

Semantic interoperability is therefore a business objective, not a technology objective, and essential to the Education Sector's functioning.

Whatever technical solution is selected, it should comply with common interoperability standards and best practice:

- Shared understanding of data definitions
- Explicit semantic model
- Preference of open standards
- Consistent implementation
- Prescriptive message schemas
- Sustainable change management

Key issues

The investigation of semantic interoperability solutions for the New Zealand Education Sector uncovered several issues:

- No global semantic model
- Variance of national semantic models
- Semantic model fragments
- Mutually exclusive XML standards
- No 'off the shelf' solutions
- Development of the New Zealand semantic Education data model
- Leading edge and evolving methodology
- Securing skill and practical experience
- Need for an open standardised methodology
- Tool support is essential

Selected solution

The New Zealand Education Sector has implemented a semantic interoperability solution, comprising:

- Custom Semantic Model
- XML Architecture
- Model-driven Architecture
- Design Methodology and Standard
- Tool Support
- Code Value and Value Validation

This solution amalgamates compatible open standards to the greatest extent possible, maximising e-GIF[1] compliance and interoperability in a broader sense.

Customisations have been kept to a minimum.

1 New Zealand e-Government Interoperability Framework: See http://www.e.govt.nz/standards/e-gif

Benefits

The benefits of the described solution are:

- Shared and documented understanding of data
- XML Schemas derived from semantic model
- XML Schemas limited to pre-defined, reusable constructs
- Opportunities to adopt and share standardised code lists
- Opportunities to improve data quality
- Opportunities to simplify application development
- Standardised XML Schema look and feel
- Standardised XML Schema versioning
- Tool supported change management
- Maximised e-GIF compliance
- Portability

Lessons learnt

A number of lessons to bring semantic interoperability to life have been learnt:

- Acknowledge interoperability as an ongoing subject matter
- Insist on long-term business and IT management support
- Base the semantic model on broad consensus
- Expect the development and maintenance of a semantic model to be time consuming
- Ensure broad ownership of the semantic model
- Keep administration of the semantic model central and narrow
- Acknowledge model-driven semantic interoperability as leading edge subject and technology
- Recognise that even open standards may necessitate customisations
- Keep administration of shared XML artefacts central and narrow
- Verify appropriate tool support for administration of XML artefacts
- Expose complexity appropriately
- Ensure build up of special skills
- Expect initial scepticism
- Expect impact on business processes
- Expect impact on message processing
- Expect impact on application development
- Expect impact on testing
- Expect a learning curve, and training needs
- Develop and impose IT governance
- Manage cultural change
- Don't expect efficiency gains too soon

Conclusion

The New Zealand Education Sector has implemented the first messages based on a semantic interoperability solution that:

- Allow partners to exchange data:
  - Without misunderstandings
  - With opportunities to improve data quality
- Meet the required solution characteristics

The technical solution described in this case study can be successfully implemented by appropriately providing supporting measures obtained from the lessons learnt.

This solution is a major step forward in achieving interoperability, not just for the Education Sector, but suitable for any other sector or industry in a similar situation.

Background

History

Capabilities of computer systems have significantly advanced in recent years, as has the number of computer systems in use. This poses a new challenge.

Challenge

Many organisations have long recognised the value of information—linking distributed information enables organisations to function with a new openness. For example, a government communicating with its citizens, or a business combining information for making well-informed decisions.

Sharing data, and thus making systems interoperable, is progressively becoming more important for a wide range of organisations, including governments. But access to distributed systems is often restricted to a select few. As a result, point-to-point data exchanges have become common. Organisations are increasingly struggling to sustain the ever-growing number of such non-standardised data exchanges fraught with inherent misunderstandings, processing errors and data quality issues.

Many organisations are acutely aware of the consequences they are suffering from inadequate interoperability and the drawbacks of point-to-point data exchanges.

Interoperability definition

Interoperability is not simple, and has many facets. A fact that is also reflected in the many definitions provided:

IEEE defines interoperability as: the ability of two or more systems or components to exchange information and to use the information that has been exchanged.

ISO/IEC 2382-01 defines interoperability as: the capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units.

These definitions focus on the technical side of interoperability. It has also been pointed out that interoperability is often more of an organisational issue, including issues of ownership, people, usability and business processes.

Paul Miller[2] provides another definition: To be interoperable one should actively be engaged in the ongoing process of ensuring that the systems, procedures and culture of an organisation are managed in such a way as to maximise opportunities for exchange and re-use of information, whether internally or externally.

Interoperability levels

Interoperability can be achieved at various levels, including:

Level 1: Technical interoperability

A communication protocol exists for exchanging data between participating systems. On this level, a communication infrastructure is established allowing systems to exchange bits and bytes, and the underlying networks and protocols are unambiguously defined.

Level 2: Syntactic interoperability

A common protocol to structure information is added: the format of the information exchange is unambiguously defined. For example, a comma delimited file exchange, or the XML syntax.

Level 3: Semantic interoperability

A common information exchange reference model is added. On this level, the meaning of the data is shared and unambiguously defined.

Higher levels of interoperability may include Pragmatic, Dynamic, Conceptual, Legal, International interoperability. These are not further considered in this case study.

Case study scope

This is a case study on semantic interoperability for the New Zealand Education Sector. It forms part of the Education Sector Architecture Framework (ESAF) programme.

Technical and syntactical interoperability are assumed in place, forming the essential basis for semantic interoperability.

Many characteristics of this case study are sector and industry independent, and so is the selected solution.

2 For details see: http://www.ariadne.ac.uk/issue24/interoperability/intro.html

Business Considerations

Background

The New Zealand Education Sector consists of various organisations, some of which are listed on the title page of this case study. While these organisations run their IT systems autonomously to fulfil their purpose, they also collaborate and share a considerable amount of information to make the Education Sector function as a whole.

Examples:

- A student moves to a new school. The student's data moves to the IT system[3] of the new school
- Schools send their enrolment data to the Ministry of Education
- TEC[4] shares the Course Register with providers and other agencies
- The Ministry provides up-to-date education provider information
- NZQA[5] receives assessment tests and returns test results

In simple terms, semantic interoperability is achieved, when:

- Date exchange partners have a documented common understanding of their shared data, and
- Data exchanges adhere to that common understanding

The Sector's stated objective for semantic interoperability is:

- "To produce a sector data model that defines shared sector data so that sector participants can provide, manage, access and understand the data."

Semantic interoperability is therefore a business objective, not a technology objective, and essential to the Education Sector's functioning.

Whatever technical solution is selected, it should comply with common interoperability standards and best practices.

Solution characteristics

Shared understanding of data definitions

Data exchange partners shall share the understanding of data definitions. A semantic model shall unambiguously define the meaning and structure of shared data.

Explicit semantic model

Data exchanges shall be based on explicit terminology, reflecting concrete business concepts. Therefore, data exchanges shall not contain abstract concepts introduced during data modelling.

The data model itself however may contain abstract concepts acting as model patterns, providing homogeny and inheritance to the explicit business concepts.

Preference for open standards

Open standards, in particular those listed under New Zealand e-Government interoperability framework (e-GIF), and other standards shall be adopted wherever feasible.

E-GIF standard divergence must be justified.

Consistent implementation

The semantic model shall be implemented consistently across data exchanges, using W3C XML 1.0[6] and W3C XML Schema 1.0[7].

Non-complying data exchange definitions should be machine-detectable.

3 Schools may chose their own IT systems and vendors

4 New Zealand Tertiary Education Commission

5 New Zealand Qualification Authority

6 For details see http://www.w3.org/XML

7 For details see http://www.w3.org/XML/Schema

Prescriptive message schemas

A message schema shall be prescriptive in regard to its minimum mandatory data content, making it simple to determine whether an XML document contains a coherent minimum set of data for processing.

Many standards simply define a message schema with a vast array of optional data items, making it the users' responsibility to define and validate the presence of the minimum required set of data.

Sustainable change management

The semantic model plus its implementations will continuously evolve. Suitable and sustainable change management shall be in place covering

- Change processes
- Artefact versioning
- Impact analysis
- Tool support

Key Issues

The investigation of possible semantic interoperability solutions for the New Zealand Education Sector uncovered several issues.

No global semantic model

Unlike for some other sectors and industries, no global semantic model exists for the Education sector.

Variance of national semantic models

A number of national semantic models exist for Education. Closer inspection of these revealed the following issues:

- The business and scope of Education varies from country to country
- A national semantic model of another country cannot be adopted if the business or scope is too different
- Limited opportunities to actively influence another country's national semantic model

Semantic model fragments

A number of semantic model fragments exist with relevance to Education. Closer inspection of these fragments revealed the following issues:

- Model fragments can overlap, causing conflicts in terminology and meaning
- The implementations of model fragments are generally of a closed scope and without extension mechanisms
- Opportunities exist to actively influence the evolution of semantic model fragments. Whether turn-around times would meet business needs remains open to discussion
- The implementations of different model fragments using different XML design standards, causing a mix of incompatible XML flavours
- The implementations of model fragments usually define the maximum allowable message content, but do not support the definition of the minimum required content
- The implementations of model fragments are often individual message schemas, and often do not support re-use and composition of more prescriptive schemas
- Providers of model fragments may provide the implementation artefacts only, withholding the semantic model, the methodology to implement the model, or the methodology to customise and extend the implementation
- Deployment of more than one model fragment and methodology inevitably leads to an inconsistent look and feel of XML messages

Mutually exclusive XML standards

Some XML standards cannot be used in conjunction with other standards.

For example:

- The XML standards OASIS UBL and OASIS xNAL are incompatible[8]
- The URN naming standards UBL NDR and NZ e-GIF are incompatible

No 'off the shelf' solutions

There is no 'off the shelf' solution for semantic interoperability in the Education Sector:

- A global, standardised and fitting semantic model does not exist

Leading edge and evolving

The transformation of a semantic model into a library of reusable XML components is leading edge and evolving.

The learning curve is steep, and prototypes are required to gain confidence and reach proof of concept.

No tool can currently automatically transform a semantic enterprise model into XML. The functionality of such generators is limited to message-specific models, and excludes re-use of XML components.

8 In the future, this incompatibility may disappear as these standards continue to evolve

Skill and experience

Skill and practical experience are difficult to secure.

Need for an open standard methodology

The transformation of any semantic model into XML requires a documented and proven methodology in order to:

- Transform consistently and traceably
- Enforce re-use and compliance
- Design according to a consistent XML standard
- Evolve with suitable versioning in place

For XML design, e-GIF recommends the open standard **OASIS UBL NDR**, which is fit for purpose in principle. However, UBL NDR rules require some customisations when used with a non-UBL semantic model. The UBL NDR editors have confirmed this being a necessity.

Before customising UBL NDR sensibly, it was essential to understand the UBL context, the UBL NDR Technical Committee's reasoning and the impact of the customisation. This proved to be a steep learning curve.

UBL NDR itself continues to evolve. Logging our customisations for future re-alignment to assure maximum UBL NDR compliance is a necessary but challenging task.

New Zealand semantic data model

Developing a national semantic model, the New Zealand Education Sector Data Model (ESDM), is time-consuming.

Tool support is essential

Keeping a semantic model and its XML implementations in synch requires robust tool support.

Because the semantic model will continue to evolve, all artefacts must be versioned.

Few tools are supporting the semantic model, its XML implementation, the dependency between them, plus versioning in an integrated manner.

Manual administration is nearly impossible without introducing many costly errors and inconsistencies.

Some modelling tools can be customised to support automated or semi-automated model consistency checks, making model administration cheaper, more manageable and reliable.

The selection of a modelling tool that is fit for this purpose and the development of the necessary customisations are essential factors for a successful implementation.

Selected Solution

The New Zealand Education Sector has analysed various options, and then selected a semantic interoperability solution.

The solution amalgamates compatible open standards to the greatest extent possible, maximising e-GIF compliance and thus interoperability in a broader sense.

Customisations have been kept to a minimum.

This described solution is suitable for any other sector or industry in a similar situation.

The solution selected by the New Zealand Education Sector comprises the following components.

Custom semantic model

In the absence of a suitable global semantic model for Education, the New Zealand Education Sector has opted to develop its own semantic model, the New Zealand ESDM.

Complying with e-GIF, the Unified Modelling Language (UML) Class Diagram is the chosen modelling notation for ESDM.

ESDM currently defines over 300 classes, 900 attributes, 300 associations and 100 generalisations, and is evolving.

The chosen design methodology and standard defines the:

- Naming standard, which is based on ISO 11179-5
- Permitted data types, which are based on UN/CEFACT data types

ESDM could easily be substituted with any other semantic data model that complies with the above standards, making this solution very portable.

XML architecture

The chosen design methodology and standard defines the XML architecture:

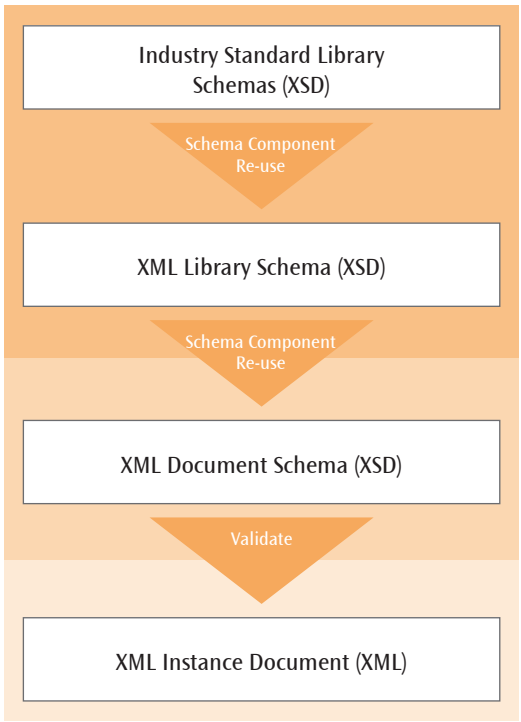
There are two types of XML documents:

- XML Instance Documents: contain actual data
- XML Schemas: define allowable XML constructs

The XML Schemas themselves are divided into:

- XML Document Schemas: defines allowable structure and content of a XML instance document
- XML Library Schema: defines the pool of reusable XML components

XML architecture



- Library Schema Level
- Document Schema Level
- Instance Document Level

This architecture enables reuse of XML components.

It also allows the methodology to restrict XML document schemas to be composed of pre-defined and thus agreed library components only.

Model-driven architecture

The UML semantic data model is the master source for shared and agreed understanding of the meaning of data.

XML Schema models are derived from the UML master model, and used to generate XML run-time schemas, which are never modified directly.

The model-driven architecture enables:

- Standard compliance checking
- Naming compliance checking
- UML vs. XML consistency checking
- Change logging
- Usage reports
- Impact analysis
- Version control
- XML schema code generation

Design methodology and standard

The Education Sector followed the New Zealand e-GIF recommendation that agencies 'consider' the OASIS NDR 2.0 methodology. This contains prescriptive rules for:

- Naming (UML and XML)
- Transforming the semantic model into XML schema
- Designing XML schema
- Versioning

OASIS UBL NDR methodology

- Naming Rules
- Transformation Rules
- Design Rules

OASIS confirms that some customisation of UBL NDR is necessary to make it work well with a non-UBL semantic model. The resulting minimal customisation is called Education Sector Language Naming and Design Rules (ESL NDR 2.0).

ESL NDR 2.0 customises, but also extends UBL NDR, enabling Education agencies to extend the Sector data model and XML library with agency-internal data items.

ESL NDR 2.0 is suitable for any other sector or industry in a similar situation.

Tool support

The Education Sector chose the Sybase Power Designer modelling tool suite.

The following tool features are an integral part of the solution:

- UML modelling
- XML schema modelling
- XML-to-UML mapping
- Customisable and automated standard compliance checks
- Customisable and standard compliant XML Schema generation
- Usage reports / impact analysis from UML to XML
- Version management
- Model repository for concurrent modelling

Sybase has addressed a number of software issues and enhancements that impeded UBL NDR-like implementations. PowerDesigner 12.1 EBF8 has been found suitable for use for this purpose.

The required PowerDesigner customisations were developed for the Education Sector by Data Management Solutions, Wellington. These customisations are largely suitable for any other sector or industry in a similar situation.

Code value and value validation

The Education Sector chose to implement OASIS UBL Methodology for Code List and Value Validation **(UMCLVV 0.8)**.

UMCLVV defines a standard XML format and meta data for code lists. UMCLVV is already used for some UN/CEFACT and OASIS code lists as well as the new Education Sector code lists.

UMCLVV also supports platform-independent content validation of XML instances, including code value lists and other values, using W3C Stylesheets.

UMCLVV is being proposed for inclusion in e-GIF in May 2007. The standard has great potential to enable interoperability of code lists and code validation, particularly if used across all of New Zealand Government.

UMCLVV may be used independently of any XML standard and methodology, and is suitable for any other sector or industry.

Summary of adopted standards

Standard Name	New Zealand e-GIF Status	Description / Usage
UML	Adopted	• Used for data modelling of the semantic model (ESDM).
XMI	Recommended	• Can be used for the interchange of meta data between modelling tools. • XMI is standard PowerDesigner functionality.
ISO/IEC 11179-5	n/a	• Naming of data elements. • Used by UBL and ESL NDR, the rules of which are based on ISO 11179-5.
UTF-8	Adopted	• Character encoding for Unicode, backwards compatible with ASCII. • Enforced via UBL/ESL NDR.
URN Naming	Under development	• ESL NDR complies with the first four urn name levels 'urn:nzl:govt:educating'. • The lower urn name levels are assigned according to UBL NDR rules.
W3C XML 1.0	Adopted	• Structured data transport
W3C XML Schema 1.0	Adopted	• Meta language to create tags to define, transit, validate and interpret data
UBL NDR	For consideration	• OASIS naming and design rules for XML schema design. • Uses ISO 11179-5 for naming rules.
ESL NDR	n/a	• The customised version of UBL NDR. • Making UBL NDR suitable for non-UBL contexts.
UMCLVV 0.8	n/a[9]	• OASIS UBL draft methodology for code list and value validation of XML messages. • Uses Xpath, Stylesheet and Schematron.
W3C Xpath 1.0	Adopted	• A language for addressing parts of an XML message. • Used by UMCLVV.
W3C Stylesheet 1.0	Adopted	• A language for transforming XML. • Used by UMCLVV.
ISO Schematron	n/a	• A language for business constraints in an XML message. • Used by UMCLVV.

9 NZ e-Gif inclusion proposed for May 2007

Benefits

The Education Sector recognises the following benefits of the selected solution described above:

Shared understanding of data

Shared understanding enables correct data exchanges without misunderstandings. The semantic model documents and visualises the shared understanding of data. It documents classes, their attributes and associations using class diagrams and textual definitions, using the proven data modelling technique and UML notation.

The versioned semantic model can be shared with data exchange partners, using the native model or published output on the web.

Derived XML schemas

All XML schemas are derived from and electronically linked with the semantic UML model. This derivation ensures that:

- UML and XML schema models remain in sync
- UML and XML names and constructs match
- Textual definitions cascade from UML to XML

XML re-use

Between the semantic model and an XML message schema sits a library of reusable XML constructs, also derived from the semantic model.

The XML library enables and enforces re-use. For example, a message schema is composed by selecting pre-defined constructs of varying granularity from the XML library.

This XML architecture ascertains that an XML message schema consists of pre-defined XML constructs only, thus confirming semantic model compliance.

Standardised code lists

The UMCLVV standard defines the Genericode format: A XML format for defining code lists and list meta data.

Various global code lists from ISO, UN/CEFACT and OASIS are already available in Genericode. Sector specific code lists also can be defined in Genericode. A Genericode list can be re-used 'as-is', restricted or extended.

An opportunity exists to use Genericode across all of New Zealand Government, and in particular for code lists of national importance defined by Statistics New Zealand.

Improve data quality

The UMCLVV standard enables platform-independent validation of XML data content without writing application programs. This provides opportunities for separating validation from internal program code.

Both sender and receiver may validate an XML message if deemed necessary, and will get the same errors for a particular message.

It is feasible to separate fatal validation errors from warnings, thus opening prospects of gradually increasing the level of data validation to improve data quality.

Simplify application development

Opportunities exist to move all business rules pertaining to what constitutes a valid XML message from the application code to the portable UMCLVV validation.

This will make application code simpler and make more agile changes possible.

Note: Truly internal business constraints however must be kept internal, and shall not be included in UMCLVV.

Standardised XML look and feel

XML messages have a standardised look and feel:

- XML constructs have the same meaning and definition across messages, projects and organisations.
- The UBL/ESL NDR methodology enforces the consistent use of XML language features, making the XML schemas uniform in appearance.

Standardised XML schema versioning

XML schemas have a standardised versioning regime:

- Across XML library, message schemas, projects and organisations
- Enabling standardised change management
- Permitting standardised message processing

Tool support

The tool supported, model-driven solution facilitates:

- Keeping semantic model and XML implementation in synch
- Enforcement of design standards
- Generation of XML schema code
- Impact analysis before applying a change
- Versioning and change management

Maximised e-GIF compliance

The maximised e-GIF compliance is aiming to:

- Simplify interoperability with future data exchange partners

Portability

The selected solution described above is portable:

- The semantic model can be substituted
- The methodology and its implementation are largely suitable for any other sector or industry in a similar situation

Lessons Learnt

The New Zealand Education Sector has learnt the following lessons during the implementation of the semantic interoperability.

Ongoing subject matter

Acknowledge interoperability as an ongoing subject matter, because interoperability cannot be achieved in a single project. Instead it is an ongoing discipline requiring resources, infrastructure and staff.

Business and IT management support

Insist on long-term business and IT management support, because the strategic goal of interoperability is implemented through orchestrated projects and infrastructure services. A single team or project is unlikely to achieve interoperability on its own, with the added risk that project achievements are forfeited when the project ends.

Semantic model consensus

Base the semantic model on broad consensus, because it represents the documented, shared understanding of shared data.

The model is an asset and the linchpin of semantic interoperability. It determines the message exchanges, and therefore requires broad consensus amongst key representatives of the data exchange partners.

Consensus is required for both the initial development and the subsequent model maintenance.

Semantic model is time consuming

Expect the development and maintenance of a semantic model to be time consuming, because the terminology used by the data exchange partners initially differs considerably. Agreeing on a shared, unambiguous language is a major undertaking and a pre-requisite for becoming semantically interoperable.

Semantic model ownership

Ensure broad and long-term ownership, because the data exchange partners, as a group, need to own the semantic model. A semantic data model is a strategic asset not just a pretty diagram. It comes with an implementation with which the data exchange partners interface in their operational environments when messages are exchanged.

Semantic model administration

Keep administration of the semantic model central and narrow, because decentralised or uncoordinated model maintenance will lead to inconsistencies or proliferation of uncontrolled model copies and versions, ultimately harming operational data exchange.

Leading edge subject

Acknowledge model-driven semantic interoperability and XML libraries as a leading edge subject and technology. It is difficult to locate reference sites and practical experience. Allow for prototypes and proof of concept work before embarking on an interoperability journey with business critical projects.

Customisation of open standards

Recognise that even open standards may necessitate customisations. The Education Sector was uncomfortable with customising the OASIS UBL NDR standard to its needs and did seek feedback. OASIS confirmed that the customisation is necessary and appropriate, giving reassurance to proceed.

XML artefact administration

Keep administration of shared XML artefacts central and narrow, because data exchange partners rely on published XML artefacts, such as XML schemas or code value lists, to be versioned, consistent and static. Disciplined file management by a designated custodian is a pre-requisite for interoperability, and also limits training needs to dedicated resources.

Conversely, decentralised or uncontrolled file management quickly can bring down interoperability through processing errors.

Tool support

Verify appropriate tool support for administration of XML artefacts, because dependencies between the UML semantic model and the many XML artefacts are almost impossible to keep consistent without robust tool support, including impact analysis and versioning.

Complexity

Expose complexity appropriately. For example, very few people need to understand the complexity of transforming the semantic model into XML libraries. A designated custodian can take care of this, while many people will only be exposed to the resulting XML schema, and if needed the underlying semantic model.

Special skills

The designated custodian (team) needs to be well trained in the special skills required for this role.

Initial scepticism

Expect initial scepticism, because the standardised XML schemas do look different and more complex. However, this sentiment is soon replaced by an appreciation of the standard look and feel of messages across projects and organisations.

Impact on business processes

Expect impact on business processes. While developing interoperable and standardised messages, the overall business process itself may become subject to re-engineering.

Impact on message processing

Expect impact on message processing, because OASIS UBL NDR provides opportunity for backwards-compatible XML schemas and platform-independent validation of XML data. Deploying such features impacts on the processing steps carried out by the messaging server.

Impact on application development

Expect impact on application development, because re-usable XML constructs and platform-independent content validation are likely to change the way applications are designed. For example, application logic becomes much simpler if an incoming message is fully validated by the messaging server, that is structure and content, and only passed on to the application if found valid.

Impact on testing

Expect impact on testing, because testing effort may partially shift from applications to platform-independent XML stylesheets, used by the messaging server.

Learning curve

Expect a learning curve and training needs for the various teams involved in implementing interoperability. The teams themselves need to function in an interoperable manner, driven by the shared interoperability goal.

IT governance

Develop and impose IT governance, because interoperability relies on standardised, central definitions of messaging interfaces and their accurate implementation. Effective governance verifies that a project does not (inadvertently) undermine the desired interoperability standard.

Cultural change

Manage cultural change, because the transition from hand-coded, non-standardised point-to-point data exchanges without governance to a model-driven semantic interoperability with XML libraries does require organisational change. A single team or project is unlikely to bring about that change.

Efficiency gains

Don't expect efficiency gains too soon from interoperability. It is a major journey, with substantial upfront investments and pre-requisites. Interoperability gains will be seen when:

- Management support is evident
- The interoperability strategy is implemented through orchestrated projects and infrastructure services
- The semantic model is stable, maintained, owned and administered
- The teams are engaged, trained and cooperating
- The culture of interoperability is apparent
- The infrastructure is robust
- The change management process is in place
- Effective governance is in place

Appendix A: Glossary

ESL NDR

The Education Sector Language Naming and Design Rules, a variant version of UBL NDR adopted by and customised for the New Zealand Education Sector to accommodate a non-UBL semantic model, such as ESDM.

ESDM

The Education Sector Data Model, the semantic model of the New Zealand Education Sector.

Genericode

A standardised XML format for code lists.
For details see:

- http://www.genericode.org/
- http://www.oasis-open.org/committees/codelist

ISO/IEC 11179 Part 5

The International Organisation for Standardization maintains this standard for naming data elements (besides many other standards).

This standard forms an integral part of UBL and ESL NDR.

New Zealand e-GIF

The e-Government Interoperability Framework is a set of policies, technical standards and guidelines. It covers ways to achieve interoperability in the public sector.

For details, see http://www.e.govt.nz/standards/e-gif

OASIS

Organisation for Advancement of Structured Information Standards.

For details, see http://www.oasis-open.org/

OASIS UBL

OASIS Universal Business Language, an OASIS Standard for electronic business.

For details, see http://www.oasis-open.org/specs/index.php – ublv2.0

OASIS UBL NDR

OASIS Universal Business Language Naming and Design Rules, a section of the OASIS UBL standard pertaining to a normative set of XML schema design rules and naming conventions for the creation of business based XML schemas.

For details, see http://www.oasis-open.org/specs/index.php – ublv2.0

Semantic model

A semantic data model defines the meaning of data unambiguously in form of a model. In this case study, the semantic model ESDM is a UML model containing class diagrams, classes, attributes, associations and their definitions.

The semantic model defines what data items and structures are permitted in compliant data exchanges, and what meaning the data items carry.

UN/CEFACT

The United Nations Centre for Trade Facilitation and Electronic Business UN/CEFACT facilitates the development of e-business standards that can cross all international boundaries and help increase interoperability and lower transaction costs.

In this context, the standardised XML data types defined by UN/CEFACT are implemented by UBL and ESL NDR.

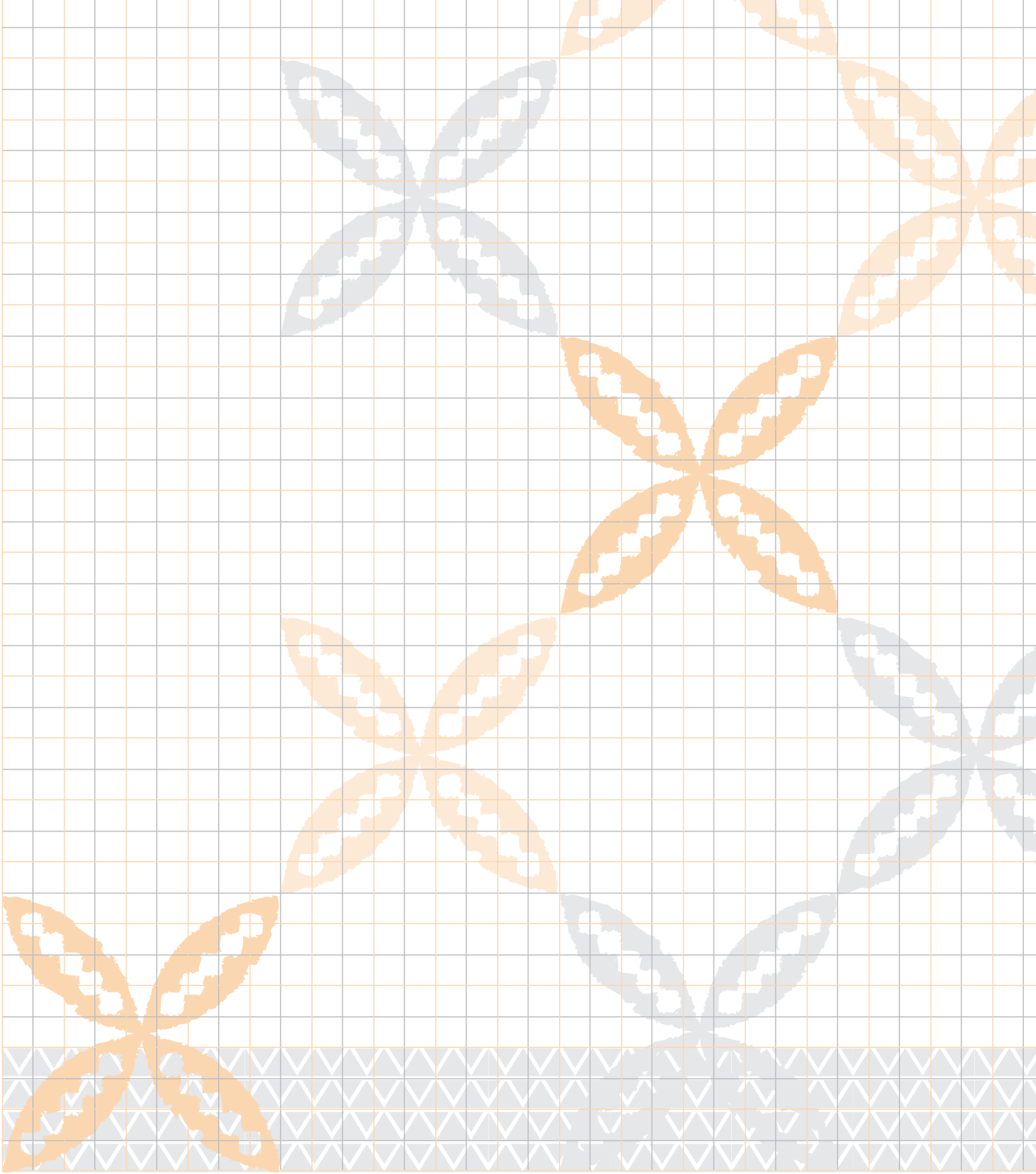
UMCLVV

OASIS UBL methodology for code list and value validation. A draft add-on to the OASIS UBL standard pertaining to the platform-independent XML validation of code lists and other values.

For details, see http://www.oasis-open.org/specs/index.php – ublv2.0

UML

Unified Modelling Language, a modelling notation suitable for object-oriented data modelling and other modelling purposes.



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