JORD Training Program Design and Background

Data collection and analysis; followed with program design for training, general instruction and consulting concerning reference data services, iRING and ISO 15926.

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Introduction

The Joint Operational Reference Data (JORD) project was created by Fiatech and PCA to ensure self-sustaining organization and infrastructure to support the ongoing definition, publication and distribution of reference data, in relation to ISO 15926 and iRING.

For this document, we call the collection of various interest groups the "broader community", meaning anyone with a stake in the outcome. The stake is most pronounced for those organizations that need services around reference data. We call these organizations that will ultimately pay for those services the "significant stakeholders".

Part of the JORD effort involves ensuring that this broader community, and especially the most significant stakeholders, are properly served with consulting, training and related instructional services. This document is intended to lay down the framework for achieving that mission.

1. Executive Summary

Goal: The goal of the training program is to support the business model as proposed 2014-04-18. Primarily, that means supporting the significant stakeholders by maximising in-kind contribution of high-value reference data content.

In this document, the analysis of existing material and the design of the training program reflect that specific goal. The ISO 15926 community is especially diverse and has many instructional needs — this document bears those interests in mind, but emphasizes that training investment must be primarily responsive to the proposed business model.

1.1 Analysis

The data collection and analysis recorded in this document identified several concerns with respect to currently available material and training services and their fit to various audiences. In order of priority, these concerns are:

- Engineers and their technology support are under served.
- Management and marketing have significant weak areas.
- Software/technology developers have several weak areas.
- Academics have at least one area that needs attention.

In this document, the term "Engineering" refers to engineers and their computer-aided engineering technology support staff as a single audience. Management, administration and planning personnel are generally grouped as "Business". Software developers and related information technology professionals are called "Technology". Marketing, academia and standards development audiences are dealt with separately.

1.2 Solution

The training program design laid out in this document addresses those problems with a mixture of new material and structured courses.

The following priorities address the immediate needs of engineering/technology, along with their managers and the broader business audience:

- contextual **material** explaining the relevance of reference data and templates to engineering
- a conventional **course** to teach engineers how to specify their information requirements
- precursor **material** describing a schematic means of representing template definitions
- supporting **material** describing a typical collaborative engagement around reference data definition, for costing and planning

Data modelers are audience members of an engineering, technology or academic background, who design reference data using the consistent requirements generated by the people trained above. A set of secondary priorities will help data modelers communicate and collaborate:

- a conventional **course** to teach how to produce complete and consistent template definitions
- precursor **material** summarizing the existing schematic means of representing the ISO 15926 part 2 ontology
- precursor **material** describing a complete methodology for ISO 15926 part 2 data modeling
- a self-service **course** to show technology professionals how to approach integration of reference data

The consulting, training and instruction group has responsibility for the deliverables in the two lists above.

1.3 Coordination

Outside of consulting, training and instruction, other deliverables are also required to support the needs of the identified audiences and industry stakeholders:

- marketing **collateral** describing successful business usage of ISO 15926
- marketing **collateral** describing the value proposition of investment in reference data and its application
- an operational **policy** document describing and mandating substantiation of reference data

These are the responsibility of other branches of the organizational entity — training cannot stand alone and must be supported by the broader initiative in order to meet the strategic goal of maximising in-kind contribution of reference data.

2. Overview

This document begins by segmenting the target audience and other criteria, and then goes on to identify subject matter. This provides some of the starting analysis of the space: who is interested and what they are interested in.

Next it moves on to data collection, by listing the organizations that currently publish source materials that support or could support our training goals. The sources are listed and cross-referenced with subject matter. These link to scores. Sources are evaluated against a shortlist of subject matter and scores are provided for each target audience/criteria of interest.

That leads to the analysis of the data. The document identifies the main audience in need (engineers), and lists the areas of their need (templates primarily). It also addresses subject matter and other audiences' needs that are not well served.

The document rounds out with a breakdown of materials and courses to develop (in rough priority order) along with their approximate costs.

3. Criteria and Audience Segmentation

In order to assess existing material, we need to determine the criteria used in scoring. For the specific goals of our training, apart from starting points like readability and consistency, the rest of our criteria relate to audience segmentation.

This section contains some summary and conclusion information about each audience - some of these conclusions are substantiated through the scores and analysis that are developed later in the document.

3.1 Criterion: Readability

Definition: Measures how readable the text is, in terms of the complexity of grammatical constructs and the use of language. This is a subjective measure based on an assessment of the appeal of the material to its broadest audience.

3.2 Criterion: Consistency

Definition: Measures the consistency of the content: how well concepts align in terms of precision and terminology, both within the document and beyond it in industry convention and academic nomenclature.

3.3 Audience: Business

Definition: The usefulness of the material to business and management: a determination of how effectively a business reader can assess the skills and effort required to apply the material. For this document, a business audience refers to the decision making capability in all of the organizations in our broader community — the people who decide where to spend money.

The main issue that business currently has is answering the question "what would it take to do X with ISO 15926", where X is some goal that the community promotes as possible. In part this is due to the lack of proper instructional support for marketing (which is addressed below). It is also however, the result of the community promoting the standard with the largest steps and the greatest possible gains, rather than incrementally useful ones.

Given that there are incrementally useful steps, it would be far better for the business audience to be supplied with concrete steps that they can take, at a knowable cost, to make plausible gains in a reasonable time frame.

In terms of material form, business is likely best served by live presentation content (also re-usable and reference-able in a standalone setting), along with conventional white papers that lay out the steps, costs and gains. Consulting engagements and related collateral are also highly desirable.

3.4 Audience: Marketing

Definition: The usefulness of the material for advocacy and marketing: a measure of how well the material supports being able to promote adoption of facets of the initiative. For this document, a marketing audience includes product management, business development, solutions engagement and pre-sales support personnel, as well as conventional marketing staff.

Separate to the marketing outputs itself, marketing internally requires a body of work that can be relied upon to be constant and simple enough to build a narrative around.

There are many challenges in the ISO 15926 community in relation to these needs: the core goals are so far reaching that the steps to get there are rarely concisely expressed. For example, even a well understood and uncontested road map would be a huge benefit to marketing the reference data service through derivative works.

Ideally, the consulting, training and instruction arm of the organizational entity that JORD is defining should act as an interpretive filter for the marketing arm. This is most likely an active engagement with explanation of services, materials and courses; along with review of marketing generated verbiage.

3.5 Audience: Engineering

Definition: The usefulness of the material to engineers: a measure of how easily a typical degree-holding engineer can parse and utilize the material. For this document, an engineering audience includes all of the computer-aided engineering technical support and solutions personnel as well — these staff are especially critical to interpreting the knowledge of engineers and will likely make up the bulk of the data modelers in a collaborative community.

An engineering audience is not expected to know anything about ontologies, formal logic, data representations or protocols. Any approach to the subject matter needs to limit the need for the absorption of any specialist knowledge in those areas.

As is made clear through the analysis in this document, engineers are under-served by the existing instructional material, which tends to require too much ancillary knowledge and does not have enough task-specific instruction. In order to serve engineers better, we need to better understand what we expect them to do with the material and to accommodate their learning style when absorbing information from non-engineering disciplines.

Guidance to this point suggests that an engineering audience would be best served by a conventional, trainer-lead group setting. The goals should anticipate the immediate application of the learned material: in other words, content needs to be relevant and tangible.

3.6 Audience: Technology

Definition: The usefulness of the material to information technology practitioners: a measure of how easily a typical IT professional can synthesize the rules into technology-related products. For this document, a technology audience refers

specifically to formally-trained, career information technology practitioners — the people who make commercial software.

A technology audience is expected to have a passing familiarity with basic data modeling concepts through exposure to relational databases, but note that the vast majority of IT professionals have not been formally trained in this area, and rely predominantly on experience and exposure. Depth and terminology vary greatly, even amongst specialists.

Some effort is required to bridge the knowledge of the average IT professional over to the application of data modeling in its ISO 15926 usage. Some effort will also be needed to understand the application of well established IETF protocols to ISO 15926-9, and the limitations and adaptions of well established W3C standards to ISO/TS 15926-8:2011, and possibly ISO 15926-12 as these evolve.

The learning style of a technology audience (at least in relation to absorbing technology concepts) is one that accommodates self-service and ad-hoc instructional documentation, with a strong reliance on test data sets and sample code and/or meta-code.

3.7 Audience: Academia

Definition: The usefulness of the material to academia, especially the degree to which it relies on or builds upon nomenclature and concepts that are part of academic literature in related fields. For this document, an academic audience includes researchers and scientists, even if they do their work in commercial companies.

Academics typically come at ISO 15926 from a background in various formal logics. Another angle into ISO 15926 comes from researchers in information systems theory and relational calculus. In both cases, their experience and uptake of ISO 15926 can be a little rocky due to the lack of consistent usage of conventional terminology for concepts in ISO 15926.

Academics could be greatly helped with a guide that expresses in conventional terms exactly how ISO 15926 part 2, part 7 and part 8 relate to their disciplines. Some material exists for the formal logics side, but is brief, dense, somewhat incomplete and buried in formal specifications. In general though, academics are reasonably well served compared with other audiences.

Academics generally have low expectations for formal training, but high expectations of formal structure in available descriptive material. For an academic audience, dry, descriptive, written material is appropriate so long as it follows the expected form, has reasonable abstracts, and ties in with established nomenclature.

3.8 Audience: Standards

Definition: The usefulness of the material to standards organizations and their membership, especially the degree to which it presents a concise specification and supports reference from other standards. For this document, a standards audience is made of people that maintain a strong presence in standards organizations.

The instructional requirements of consumers of ISO 15926 from the standards audience segment have largely been met, simply due to the ISO process itself providing the governing approach that generates the needed level of content.

More complete abstracts for reference outside of the ISO pay wall would be welcome, however it is likely this gap would be reasonably addressed by material aimed at other audiences (particularly technology and academia).

In general, this document takes the perspective that standards definition and promulgation audiences are well served and do not need to be targeted by JORD, especially since their formal needs with respect to the standard lie outside of the reference data ambit of JORD.

4. Subject Areas and Subject Matter

Throughout this document, the subject matter listed in this section is frequently referred to (and linked). In particular source material, material for development and course module content are expressed in terms of how they relate to the subject matter listed in this section.

To provide some additional structure, the subject matter is grouped into broader subject areas. The [summary] notation links ahead to the score summary for the subject matter aggregated against the available source material.

4.1 Subject Area: Context

Contextual documentation is needed especially by business and marketing. This is typically vision statements, road maps, white papers and so forth. The content should explain how the reference data initiative fits into the broader industry setting.

4.1.1 Subject Matter: Objectives

Audience/Criteria: Business and Marketing.
[summary]

Overview documentation describing the goals of the standards and initiatives. Primarily for a business/marketing audience, objectives must communicate the skills and costs needed meet the goals.

4.1.2 Subject Matter: Road Map

Audience/Criteria: Business and Marketing.
[summary]

Documentation describing the path to achieving the goals of the JORD. Road map collateral should lay out a step-wise path to achieving the goals set down in objectives and ensure that if parts of the initiative are in development, a meaningful schedule is provided.

4.1.3 Subject Matter: Justification

Audience/Criteria: Business and Marketing.
[summary]

Evidence such as value propositions and demonstrated business usage that justifies the investments required (in-kind and direct). This is primarily required for the business audience that needs to be able to literally justify the costs expended engaging in reference data definition and collaboration to their senior management.

4.2 Subject Area: Modeling

The modeling subject area concerns the shape of the information that describes target concepts, at various levels (syntactic, semantic, rules and constraints).

4.2.1 Subject Matter: Ontology

Audience/Criteria: Academia and Technology.
[summary]

Ontology subject matter deals with modeling information as atomic truth statements. This can deal with both real things in time and space, but also abstractions. For our particular application, we also use ontology as a short-hand to group subject matter that deals with a purely binary relation approach to modeling.

Subject matter relating to ontology includes part 2 of the standard and some of the other initiatives that are in progress such as part 12. Parts 7 and 8 also relate to ontology via their links to part 2 and to OWL.

4.2.2 Subject Matter: Geometry

Audience/Criteria: Technology and Academia.
[summary]

Geometry describes the shapes of target concepts: as three dimensional structures manifest in the physical world, as formal abstractions such as circuit diagrams and piping and instrumentation diagrams.

4.2.3 Subject Matter: Templates

Audience/Criteria: Technology, Academia and Engineering.
[summary]

Template subject matter treats information as compound statements. We mean compound in the sense that a template can tie together two or more different things, rather than just two.

This subject matter also addresses the connection of this kind of finitary relationship modeling to the binary relationship modeling of ontology. The main audience for this subject matter is people responsible for generating reference data content.

4.3 Subject Area: Exchange

Exchange subject matter deals with the exchange of data, what form it takes, how the exchange happens, and where the master resides, when masters have to be identified and so forth.

4.3.1 Subject Matter: Representation

AUDIENCE/CRITERIA: Technology.
[summary]

Representation addresses the digital interchange form that data takes at both structural and syntactic levels. This level of representation is almost wholly aimed at information technology professionals: most other users should be utilizing tools or processes that are built and designed by information technology professionals to deal with information at this level.

4.3.2 Subject Matter: Network Protocols

AUDIENCE/CRITERIA: Technology and Business.
[summary]

Descriptions of the protocols and services that support data exchange. Again, this is primarily subject matter for information technology professionals, who need to know exactly how information is exchanged, what events drive that exchange and how the data may (or may not) change.

A business audience can benefit somewhat from accurate overview documentation that describes the features that limit the overall exchange of data, especially with regard to change management, since this affects workflow planning.

4.3.3 Subject Matter: Authorization Model

AUDIENCE/CRITERIA: Technology and Business.
[summary]

Subject matter that describes how authorizations are declared, their granularity, cache-ability and reach. This affects the implementation of protocols as described in the previous section, but is also needed when dealing with the internals of tool implementation.

Intended almost wholly for a technology audience, this needs to guide the technology audience in the rules around authorization declaration and interpretation. A business audience could also benefit from introductory and overview materials addressing this subject matter, since that can govern the conceptualization of solutions based on the technology itself. However, since most business audiences will have technology staff to provide interpretation around this subject matter, it should not be a high priority.

4.3.4 Subject Matter: Testing and Conformance

AUDIENCE/CRITERIA: Technology, Academia and Standards.
[summary]

The criteria and process used for testing conformance of data and services to specifications. From a technology audience perspective, the validation criteria are less important than the process, declarative inputs and types of tools used to actually measure data validity, and software conformance, so this subject matter is in fact distinct from validation proper.

While the primary audience is certainly technology for this subject matter, academic and standards audiences also have some needs for descriptive material in this area. This is almost certainly going to be the case if the conformance suites evolve outside of the standards process, which seems likely. Even so, the needs of the technology audience prevail here, since the other audiences will likely be making use of the technology experience after the fact.

4.4 Subject Area: Reference Data

This subject area covers data that describes the shape of other data or provides related constants, along with its creation, definition and publishing.

Aside from the subject matter already addressed under other areas (particularly see Modeling and Exchange above), this is mostly oriented at the audiences that use reference data (primarily engineers) and that define reference data (primarily engineers, technology and academia).

To take a closer look at that audience breakdown, we largely see engineers as the consumers of reference data and the use case definers. Some engineers will be responsible for discipline-level abstraction of reference data. Technology professionals, especially data modeling experts, will be responsible for broader abstraction, while academia or dedicated researchers will likely be responsible for core definitions and critical assessment.

4.4.1 Subject Matter: Registry

AUDIENCE/CRITERIA: Business,

Registry subject matter deals with the various registries for reference data, their organization, constraints, recommended usage and available services.

Audience/Criteria: Engineering, Technology and Standards.
[summary]

Engineering and management audiences are interested in information at this level because it affects how they use reference data in their work and how that work is planned.

Technology audiences and management are interested in registry subject matter, primarily in terms of the services that can be used to integrate against registries, and the terms under which those integrations can operate (network behaviour, service level guarantees and so forth).

4.4.2 Subject Matter: Collaboration

Audience/Criteria: Engineering and Technology.
[summary]

Collaboration subject matter deals with the processes and guidance for collaboration around the creation and publication of reference data.

This is primarily of interest engineering and technology audiences who are expected to have the highest use of the collaborative space. Their respective managers will also need to understand the limits of the collaborative process in order to cost and schedule effort dependent on reference data outputs.

4.4.3 Subject Matter: Definition

Audience/Criteria: Engineering and Technology.
[summary]

Definition subject matter is the guidance and methodology around the definition of reference data. This area in particular requires much stronger support for the primary audiences than is currently available.

The engineering audience is particularly poorly served with respect to this subject matter, and it has been identified as a priority in order to accelerate the generation of large volumes of reference data content.

A technology audience will have lower barriers than an engineering audience when approaching this material (since its part of their discipline), so they can leverage material designed for an engineering audience.

4.4.4 Subject Matter: Constraints

Audience/Criteria: Engineering and Technology.
[summary]

Constraints subject matter concerns the constraints that govern reference data.

As for definition subject matter, while it is available, constraints subject matter tends to be expressed in a form that is not particularly useful to a technology audience, and practically intractable for a typical engineering audience. This must be remedied.

4.4.5 Subject Matter: Substantiation

Audience/Criteria: Engineering, Business and Technology.
[summary]

Substantiation subject matter concerns guidance around and requirements for substantiating reference data definitions. Support for this subject matter is practically non-existent at any level, as far as can be established.

The primary audiences for this subject matter are: engineering (who need to know what they need to supply in terms of test data that backs their use cases and references that back their definitions); technology (who need to assist with the interpolation and comparison of test data when merging discipline-specific definitions or creating more broadly abstracted definitions); business/management (who need to understand the needs and account for the legal release of such data and content for collaborative effort).

The form of this subject matter could be a simple policy document, but nevertheless, it is absolutely needed for a collaborative process to generate meaningful consensus.

4.4.6 Subject Matter: Validation

Audience/Criteria: Business, Technology, Academia and Engineering.
[summary]

Validation subject matter deals with how data is validated against reference data content. Primarily, this is intended for audiences involved in capital project handover.

Those audiences will include business, who have to understand what needs to be accounted for, technology who need

to understand the specifics of the mechanism, research/academia, who will likely be involved in assessing the results and engineering who need to understand the limits of what the validation entails (so that they know what else needs to be checked to fulfill their own obligations with respect to handover, for example).

4.4.7 Subject Matter: Contribution

AUDIENCE/CRITERIA: Engineering, Business and Technology. [summary]

Contribution subject matter describes the process for contribution, collaboration and publication of reference data definitions.

This is of primary importance to the engineering and technology audiences, who will need to know how to participate. In addition, overview guidance is needed for business to understand how participation works, where costs are encountered and what service level guarantees are associated with the process.

Existing subject matter in this area is largely constrained to an explanation of the submission process, though there is also some guidance being made available on how to submit. The rest of the needs of this subject are largely unmet.

4.4.8 Subject Matter: Application

AUDIENCE/CRITERIA: Engineering, Business and Technology. [summary]

Application subject matter describes how to use it in practice. In other words, all the different ways in which it can be applied to solve real world problems.

This is of primary interest to business, engineering and technology audiences, but each audience will need its own specific and separate support in this area. None of that exists at the current point in time.

5. Organizations and Source Materials

This section lists instructional source materials available in English relating to the whole initiative around ISO 15926 and iRING as of 2014-03-16.

The purpose of this is to identify the gaps and weaknesses in the available materials, so as to properly plan to deliver a comprehensive set of training, consulting and instructional documentation.

Each organization is listed along with their relevant source material. These are cross referenced against various subject matter. The same subject matter can be addressed by multiple sources and organizations.

The [external] notation links to an external web site; the [scores] notation links ahead to the tabulated scores for the source material in question; and the [quote] notation indicates text quoted from an external site.

5.1 Organization: ISO [external]

ISO manages the publication of formal documentation relating to the whole initiative. While the suite of standards started outside of ISO, the ISO 15926 banner has absorbed most of the formalization effort around the initiative.

In some ways, this has been problematic because while documents have been given the *imprimatur* of ISO, the actual content has in many cases never been properly implemented by a sizeable group of disparate parties. Reference implementations are scarce (and not generally consistent with the documents).

5.1.1 Source: ISO 15926-1:2004 [external]

SUBJECTS ADDRESSED: Objectives. [scores]

Industrial automation systems and integration -- Integration of life-cycle data for process plants including oil and gas production facilities -- Part 1: Overview and fundamental principles [quote]

5.1.2 Source: ISO 15926-2:2003 [external]

SUBJECTS ADDRESSED: Ontology. [scores]

Industrial automation systems and integration -- Integration of life-cycle data for process plants including oil and gas production facilities -- Part 2: Data model. [quote]

5.1.3 Source: ISO 15926-3:2009 [external]

SUBJECTS ADDRESSED: Geometry. [scores]

Industrial automation systems and integration -- Integration of life-cycle data for process plants including oil and gas production facilities -- Part 3: Reference data for geometry and topology. [quote]

5.1.4 Source: ISO/TS 15926-4:2007 [external]

SUBJECTS ADDRESSED: Registry. [scores]

Industrial automation systems and integration -- Integration of life-cycle data for process plants including oil and gas production facilities -- Part 4: Initial reference data. [quote]

5.1.5 Source: ISO/TS 15926-4:2007/Amd 1:2010 [external]

SUBJECTS ADDRESSED: Registry.

Industrial automation systems and integration -- Integration of life-cycle data for process plants including oil and gas production facilities -- Part 4: Initial reference data. 2010 amendment. [quote]

5.1.6 Source: ISO/TS 15926-6:2013 [external]

SUBJECTS ADDRESSED: Validation. [scores]

Industrial automation systems and integration -- Integration of life-cycle data for process plants including oil and gas production facilities -- Part 6: Methodology for the development and validation of reference data. [quote]

5.1.7 Source: ISO/TS 15926-7:2011 [external]

SUBJECTS ADDRESSED: Templates. [scores]

Industrial automation systems and integration -- Integration of life-cycle data for process plants including oil and gas production facilities -- Part 7: Implementation methods for the integration of distributed systems: Template methodology. [quote]

5.1.8 Source: ISO/TS 15926-8:2011 [external]

SUBJECTS ADDRESSED: Representation. [scores]

Industrial automation systems and integration -- Integration of life-cycle data for process plants including oil and gas production facilities -- Part 8: Implementation methods for the integration of distributed systems: Web Ontology Language (OWL) implementation. [quote]

5.1.9 Source: ISO 15926-9

SUBJECTS ADDRESSED: Network Protocols. [scores]

Network services and protocols for data exchange [in development].

5.1.10 Source: ISO 15926-10

SUBJECTS ADDRESSED: Testing and Conformance.

Testing approaches in development.

5.1.11 Source: ISO/DTS 15926-11 [external]

SUBJECTS ADDRESSED: Application. [scores]

Industrial automation systems and integration -- Integration of life-cycle data for process plants including oil and gas production facilities -- Part 11: Methodology for simplified industrial usage of reference data. [quote]

5.1.12 Source: ISO 15926-12

OWL2 representation in development, not sure if its part 2 or part 7.

5.2 Organization: PCA [external]

POSC Caesar Association (PCA) is a non-profit global-standardization member organization that shall promote the

development of open specifications to be used as standards for enabling the interoperability of data, software and related matters. PCA initiated ISO 15926 Integration of life-cycle data for process plants including oil and gas production facilities" and is committed to its maintenance and enhancement. [quote]

PCA has extensive literature concerning ISO 15926 and the RDL and RDS initiatives that directly relate to JORD's goals.

5.2.1 Source: Wiki General

SUBJECTS ADDRESSED: Objectives. [scores]

The general site mostly contains operational descriptions, and design considerations, not instructional information. As a result, its not particularly fit for purpose for instruction (which is not its intent). Scoring follows that observation (and for the remainder of the materials as well).

5.2.2 Source: Model

SUBJECTS ADDRESSED: Ontology. [scores]

Material dealing with modeling is available on the site, but generally deals with it in very abstract terms. The abstract information is useful only from a technology and business point of view.

5.2.3 Source: PCA RDL

SUBJECTS ADDRESSED: Registry. [scores]

The PCA RDL is the main registry of classes for ISO 15926 outside of the standard proper (and is the source of the class registry elements of the standard).

There is some documentation suitable for an academic and/or technology audience in relation to using the registry. Other documentation deals with submitting to the registry.

5.2.4 Source: TSPs

SUBJECTS ADDRESSED: Templates. [scores]

Template Signature Patterns (TSPs) are a kind of template pattern that has been dealt with in depth under the auspices of the JORD project. While it is not currently released, it is available to JORD members. Scores are expected to improve as the material matures (last evaluated in 2013 and substantial progress is understood to have been made).

5.3 Organization: Fiatech [external]

Fiatech is an international community of passionate stakeholders working together to lead global development and adoption of innovative practices and technologies to realize the highest business value throughout the life cycle of capital assets. [quote]

Fiatech's primary role with respect to ISO 15926 and iRING is as an implementation community and advocate, not primarily a generator of documentation and reference. Even so, there are significant materials generated by the community, and as an organization it is heavily invested in JORD.

5.3.1 Source: EDRC [external]

SUBJECTS ADDRESSED: Registry, Templates and Representation. [scores]

The primary objective of EDRC is to establish a common understanding across industry projects of how to use ISO 15926 and how to assess software conformance to specified ISO 15926 data structures and capabilities. Collaboration with MIMOSA on the OGI Pilot is a cornerstone of this project. EDRC will focus on a narrow scope limited to equipment and system data that is common with the OGI Pilot and HEED project, and consistent with the objectives of the ISO 15926 Information Patterns (IIP) project. [quote]

5.3.2 Source: IIP [external]

SUBJECTS ADDRESSED: Templates and Representation.

Development of consensus-based ISO 15926 template information patterns and creation of data layer software for key industry tools.

5.3.3 Source: IIMM [external]

ISO 15926 is designed to provide interoperability of information for the life cycle of process plants. In 2009, Proteus defined the models for P&ID and 3D captured in an XML Schema (Proteus 3.3.3). This schema is now supported by several vendors with many deployments in industry. Since 2009, ISO 15926 has evolved and a key new method is becoming available for definition and transport. This project, in partnership with POSC Caesar Association (PCA), will align the two methods so business can use current methods along with the new method. [quote]

5.4 Organization: iRINGToday [external]

iRINGToday is an online community site dedicated to keeping the industry up to date and informed about the latest developments, news, and events surrounding iRING, the global information interoperability solution architecture based on the ISO 15926 reference data standard that enables high fidelity information interoperability across the lifecycle of capital facility operations and projects. [quote]

5.4.1 Source: An Introduction to ISO 15926 [external]

SUBJECTS ADDRESSED: Objectives and Templates.
[scores]

5.5 Organization: iRINGTools User Group [external]

iRINGTools User Group is an open online community of users, companies, and organizations who use, are considering using, or are developing or deploying iRING solutions. The iRINGTools User Group is also responsible for the management, enhancement, and maintenance of iRINGTools software and the iRINGSandbox Showroom. [quote]

5.5.1 Source: GS Concepts 001 [external]

SUBJECTS ADDRESSED: Objectives and Templates.

5.6 Organization: USPI-NL

5.6.1 Source: Site

SUBJECTS ADDRESSED: Ontology and Registry.

5.7 Organization: KAIST [external]

KAIST (formerly also known as Korea Advanced Institute of Science and Technology) is a public research university located in Daedeok Innopolis, Daejeon, South Korea.

KAIST have long-standing involvement in ISO 15926, including utilization of the iRINGTools and modeling of plant equipment in ISO 15926. The primary resources applicable to the instruction survey are published in Korean, which leaves the specifics off this list.

5.8 Organization: DEXPI [external]

DEXPI (Data Exchange in Process Industry) is a joint initiative by industry partners based in Germany. The objective is to develop and promote a general standard for the process industry covering all phases of the lifecycle of a (petro-)chemical plant, ranging from specification of functional requirements to assets in operation.

DEXPI provide service endpoints, a collaborative space, and some online validation tools. Backing these there are various presentations and some related documentation, largely advocacy.

5.8.1 Source: Site [external]

SUBJECTS ADDRESSED: Objectives.

Incomplete: The DEXPI site needs in depth review and coverage and then some meaningful scoring and corroboration: a shallow dive hasn't shown a lot of evidence for the kind of material that is missing according to our analysis, so for now, that action is deferred.

5.9 Organization: Wikipedia [external]

Wikipedia is a multilingual, web-based, free-content encyclopedia project supported by the Wikimedia Foundation and based on an openly editable model.

5.9.1 Source: ISO 15926 [external]

Subjects Addressed: Objectives.

Wikipedia's introductory page on ISO 15926, with contributions and discussions largely generated by the standards authors and related parties.

5.10 Organization: IETF [external]

The IETF's mission is to make the Internet work better, by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet. [quote]

5.10.1 Source: RFC2616 [external]

Subjects Addressed: Network Protocols.
[scores]

The Hypertext Transfer Protocol (HTTP) is an application-level protocol for distributed, collaborative, hypermedia information systems. It is a generic, stateless, protocol which can be used for many tasks beyond its use for hypertext, such as name servers and distributed object management systems, through extension of its request methods, error codes and headers. A feature of HTTP is the typing and negotiation of data representation, allowing systems to be built independently of the data being transferred. [quote]

5.10.2 Source: RFC4510 [external]

Subjects Addressed: Network Protocols.
[scores]

The Lightweight Directory Access Protocol (LDAP) is an Internet protocol for accessing distributed directory services that act in accordance with X.500 data and service models. This document provides a road map of the LDAP Technical Specification. [quote]

5.10.3 Source: RFC6101 [external]

Although the SSL 3.0 protocol is a widely implemented protocol, a pioneer in secure communications protocols, and the basis for Transport Layer Security (TLS), it was never formally published by the IETF, except in several expired Internet-Drafts. This allowed no easy referencing to the protocol. We believe a stable reference to the original document should exist and for that reason, this document describes what is known as the last published version of the SSL 3.0 protocol, that is, the November 18, 1996, version of the protocol. [quote]

5.10.4 Source: RFC5246 [external]

Subjects Addressed: Network Protocols.
[scores]

This document specifies Version 1.2 of the Transport Layer Security (TLS) protocol. The TLS protocol provides communications security over the Internet. The protocol allows client/server applications to communicate in a way that is designed to prevent eavesdropping, tampering, or message forgery. [quote]

5.10.5 Source: RFC4918 [external]

Web Distributed Authoring and Versioning (WebDAV) consists of a set of methods, headers, and content-types ancillary to HTTP/1.1 for the management of resource properties, creation and management of resource collections, URL namespace manipulation, and resource locking (collision avoidance). [quote]

5.10.6 Source: RFC1035 [external]

SUBJECTS ADDRESSED: Network Protocols. [scores]

This RFC describes the details of the domain system and protocol, and assumes that the reader is familiar with the concepts discussed in a companion RFC, "Domain Names - Concepts and Facilities" [RFC-1034]. [quote]

5.11 Organization: W3C [external]

The World Wide Web Consortium (W3C) is an international community where Member organizations, a full-time staff, and the public work together to develop Web standards. [quote]

5.11.1 Source: XML [external]

SUBJECTS ADDRESSED: Representation. [scores]

Extensible Markup Language (XML) is a simple, very flexible text format derived from SGML (ISO 8879). Originally designed to meet the challenges of large-scale electronic publishing, XML is also playing an increasingly important role in the exchange of a wide variety of data on the Web and elsewhere. [quote]

UTILIZATION: XML is used in ISO/TS 15926-8:2011 via the application of RDF (via OWL) as a means of exchanging first-order logic projections of template definitions. XML is also used in many other ways to solve information representation issues in the broader community.

5.11.2 Source: RDF [external]

SUBJECTS ADDRESSED: Representation. [scores]

RDF is a standard model for data interchange on the Web. RDF has features that facilitate data merging even if the underlying schemas differ, and it specifically supports the evolution of schemas over time without requiring all the data consumers to be changed. [quote]

UTILIZATION: RDF (along with RDFS and OWL) is used in ISO/TS 15926-8:2011 as an abstract representation of first-order logic projections of template definitions. RDF has also been used in several other ways to represent templates by the broader community.

5.11.3 Source: RDFS [external]

SUBJECTS ADDRESSED: Representation. [scores]

RDFS is a general-purpose language for representing simple RDF vocabularies on the Web. Other vocabulary definition technologies, like OWL or SKOS, build on RDFS and provide language for defining structured, Web-based ontologies which enable richer integration and interoperability of data among descriptive communities. [quote]

UTILIZATION: RDFS is implied by usage of OWL. See also how RDF is used by the ISO 15926 community.

5.11.4 Source: SPARQL [external]

SUBJECTS ADDRESSED: Representation. [scores]

RDF is a directed, labeled graph data format for representing information in the Web. This specification defines the syntax and semantics of the SPARQL query language for RDF. SPARQL can be used to express queries across diverse data sources, whether the data is stored natively as RDF or viewed as RDF via middleware. SPARQL contains capabilities for querying required and optional graph patterns along with their conjunctions and disjunctions. SPARQL also supports extensible value testing and constraining queries by source RDF graph. The results of SPARQL queries can be results sets or RDF graphs. [quote]

UTILIZATION: SPARQL is supported by current PCA and other service offerings for reference data distribution. It is also required by ISO 15926-9.

5.11.5 Source: XSL [external]

XSL is a family of recommendations for defining XML document transformation and presentation. [quote]

Utilization: XSL has had significant use in the broader community for transformation between various different XML representations of template definitions and data.

5.11.6 Source: XSD [external]

XML Schemas express shared vocabularies and allow machines to carry out rules made by people. They provide a means for defining the structure, content and semantics of XML documents. [quote]

Utilization: XSD (and DTD) have both been used for representations of templates and, more significantly, for parameterizing the literal data types in both standard and non-standard representations of templates.

5.11.7 Source: OWL [external]

The W3C Web Ontology Language (OWL) is a Semantic Web language designed to represent rich and complex knowledge about things, groups of things, and relations between things. OWL is a computational logic-based language such that knowledge expressed in OWL can be exploited by computer programs, e.g., to verify the consistency of that knowledge or to make implicit knowledge explicit. OWL documents, known as ontologies, can be published in the World Wide Web and may refer to or be referred from other OWL ontologies. OWL is part of the W3C's Semantic Web technology stack, which includes RDF, RDFS, SPARQL, etc. [quote]

Utilization: For details, see how RDF is used by the ISO 15926 community.

5.11.8 Source: WS [external]

WSDL is an XML format for describing network services as a set of endpoints operating on messages containing either document-oriented or procedure-oriented information. The operations and messages are described abstractly, and then bound to a concrete network protocol and message format to define an endpoint. Related concrete endpoints are combined into abstract endpoints (services). WSDL is extensible to allow description of endpoints and their messages regardless of what message formats or network protocols are used to communicate, however, the only bindings described in this document describe how to use WSDL in conjunction with SOAP 1.1, HTTP GET/POST, and MIME. [quote]

Utilization: Web Services and foundation specifications such as WSDL are implied by several RDF standards, such as latter versions of SPARQL. It is also part of the general discussion around ISO 15926 part 9.

5.11.9 Source: SOAP [external]

SOAP, originally defined as Simple Object Access Protocol, is a protocol specification for exchanging structured information in the implementation of web services in computer networks. It relies on XML Information Set for its message format, and usually relies on other application layer protocols, most notably Hypertext Transfer Protocol (HTTP) or Simple Mail Transfer Protocol (SMTP), for message negotiation and transmission. [quote]

Utilization: SOAP is part of Web Services and is also are implied by several RDF standards, such as earlier versions of SPARQL (and by implication latter versions as well). An understanding of SOAP is required to grasp the architectural limits of the several ISO 15926 propositions.

5.12 Organization: OASIS [external]

OASIS is a non-profit consortium that drives the development, convergence and adoption of open standards for the global information society. [quote]

OASIS promotes industry consensus and produces worldwide standards for security, Internet of Things, cloud computing, energy, content technologies, emergency management, and other areas. OASIS open standards offer the potential to lower cost, stimulate innovation, grow global markets, and protect the right of free choice of technology. [quote]

5.12.1 Source: WS-Security [external]

Web Services Security (WS-Security, WSS) is an extension to SOAP to apply security to Web services. It is a member of the Web service specifications and was published by OASIS. The protocol specifies how integrity and confidentiality can be enforced on messages and allows the communication of various security token formats, such as Security Assertion Markup Language (SAML), Kerberos, and X.509. Its main focus is the use of XML Signature and XML Encryption to provide end-to-end security. [quote]

Utilization: For details, see how RDF is used by the ISO 15926 community.

6. Current Service Scores

Source material is scored on two axes: how much the given material is needed for given criteria (need); how much the given material is valuable for given criteria (value). Scores are represented as "need/value" with each being a number between zero and nine.

6.1 Color Scoring Key

Color is also used to illuminate the results, with greater saturation being indicative of higher need and the spectrum red to yellow to blue indicating value (red is low value, blue is high). Omitted values appear in white, for example where the criteria are not relevant to the subject matter.

Value (right) / Need (below)	0	1	2	3	4	5	6	7	8	9	Need Described
0	0/0	0/1	0/2	0/3	0/4	0/5	0/6	0/7	0/8	0/9	
1	1/0	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	limited
2	2/0	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	
3	3/0	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	low
4	4/0	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	
5	5/0	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	moderate
6	6/0	6/1	6/2	6/3	6/4	6/5	6/6	6/7	6/8	6/9	
7	7/0	7/1	7/2	7/3	7/4	7/5	7/6	7/7	7/8	7/9	high
8	8/0	8/1	8/2	8/3	8/4	8/5	8/6	8/7	8/8	8/9	
9	9/0	9/1	9/2	9/3	9/4	9/5	9/6	9/7	9/8	9/9	necessary
Value Described:		poor		below		average		above		good	not specified or not available

6.2 Source Materials Score Chart

To interpret the scores in the following chart, simply look for areas that are bright red to bright yellow: these indicate audiences (along the top) that are under-served with respect to current source material (on the left). When an audience has a high need for a material and no satisfactory material, this indicates a problem that needs to be addressed. The grey areas either have not been assessed yet, or do not need to be for the specific criterion.

Organization	Source	Subject Matter	Scores							
			Readability	Consistency	Business	Marketing	Engineering	Technology	Academia	Standards
ISO	ISO 15926-1:2004	Objectives	8/8	8/7	6/3	6/2	1/1	4/5	5/6	9/9
	ISO 15926-2:2003	Ontology	8/5	9/6			2/1	8/6	8/5	9/9
	ISO 15926-3:2009	Geometry						7/4	5/6	9/6
	ISO/TS 15926-4:2007	Registry		9/5			9/3	8/6	3/6	9/7
	ISO/TS 15926-6:2013	Validation	8/8	8/6	6/3			9/2		9/6

Organization	Source	Subject Matter	Scores							
			Readability	Consistency	Business	Marketing	Engineering	Technology	Academia	Standards
	ISO/TS 15926-7:2011	Templates	8/6	8/6			*9/1	7/5	9/7	9/8
	ISO/TS 15926-8:2011	Representation					1/1	9/6	7/6	9/7
	ISO 15926-9	Network Protocols						9/3	3/2	9/5
	ISO/DTS 15926-11	Application			8/2		*9/1	6/6		9/6
PCA	Wiki General	Objectives	8/4	*8/2	9/5	9/2	9/3	6/8	3/8	2/9
	Model	Ontology			5/5			8/5	8/8	1/8
	PCA RDL	Registry	8/8	8/7	6/3	6/2	1/1	4/5	5/6	9/9
	TSPs	Templates			7/4	8/2	*9/1	9/3	9/7	7/7
Fiatech	EDRC	Registry			7/5	7/3	8/3	9/7	2/6	4/5
		Templates			8/3	7/3	8/1	5/7		
		Representation						8/6		
iRINGToday	An Introduction to ISO 15926	Objectives	8/8	8/7	9/5	9/6	*!7/4	7/3		
		Templates	9/9	*9/2	8/3	*7/2	9/2	6/5		
IETF	RFC2616	Network Protocols	9/7	9/9				9/9		9/9
	RFC4510	Network Protocols	9/6	9/8				9/7		9/9
	RFC5246	Network Protocols	9/8	9/9				9/8		9/8
	RFC1035	Network Protocols	9/7	9/8				9/9		9/8
W3C	XML	Representation	9/9	9/9				9/9		9/9
	RDF	Representation	9/7	9/8				9/9		9/9
	RDFS	Representation	9/7	9/6				9/8		9/7
	SPARQL	Representation	9/7	9/8				9/7		9/8

6.3 Subject Matter Score Chart

The following chart summarizes the source materials score chart by aggregating the data over subject matter. Similarly, the problem areas are in the bright red through orange to yellow range, but white areas also indicate problems: either missing assessment or completely missing support.

Note that this chart could be improved - it currently uses the maximum value and the average need over the aggregate of the material for any subject matter or subject area. It should likely calculate this a little differently when aggregating for subject areas.

Subject Matter	Scores							
	Readability	Consistency	Business	Marketing	Engineering	Technology	Academia	Standards
Context	8/8	8/7	8/5	8/6	6/4	6/8	4/8	6/9
Objectives	8/8	8/7	8/5	8/6	6/4	6/8	4/8	6/9
Road Map			n/a	n/a				
Justification			n/a	n/a				
Modeling	8/9	9/6	7/5	7/3	7/2	7/7	8/8	7/9
Ontology	8/5	9/6	5/5		2/1	8/6	8/8	5/9
Geometry						7/4	5/6	9/6
Templates	9/9	9/6	8/4	7/3	9/2	7/7	9/7	8/8
Exchange	9/9	9/9			1/1	9/9	5/6	9/9
Representation	9/9	9/9			1/1	9/9	7/6	9/9
Network Protocols	9/8	9/9	n/a			9/9	3/2	9/9
Authorization Model			n/a			n/a		

Subject Matter	Scores							
	Readability	Consistency	Business	Marketing	Engineering	Technology	Academia	Standards
Testing and Conformance						n/a	n/a	n/a
Reference Data	8/8	8/7	7/5	7/3	7/3	7/7	3/6	8/9
Registry	8/8	9/7	7/5	7/3	6/3	7/7	3/6	7/9
Collaboration					n/a	n/a		
Definition					n/a	n/a		
Constraints					n/a	n/a		
Substantiation			n/a		n/a	n/a		
Validation	8/8	8/6	6/3		n/a	9/2	n/a	9/6
Contribution			n/a		n/a	n/a		
Application			8/2		9/1	6/6		9/6

7. Analysis and Design

The main observation is that service offerings are not comprehensive or well suited to most audiences, especially engineers. We must target information more appropriately for different audiences and insulate them from the need to absorb large corpora outside of their own disciplines.

7.1 Current Service Offerings

The current service offers very good support for those directly involved in the standards initiative, good support for academia and reasonable support for software and technology, with some weak areas.

Business has adequate support in those areas where it exists, but there are large gaps. Marketing has had weak support with little funding available for proper white papers and other consulting focus support

Worst served are engineers, who face a lot of material but much of it is ill-suited to their conventional learning style and expectations for organization of content.

7.2 Analysis of Situation

In general, the problem with the material available is that it tries to target all audiences. This is an understandable expediency when funding is limited.

In practice that has also lead to a lack of recognition of where there need to be boundaries between sets of knowledge. These boundaries need to set by audience discipline.

Once the boundaries are set (which this document does through audience and subject matter separation), it becomes easier to determine where and how to insulate one discipline from another, so that a participant does not need to know everything, just enough about their area of participation.

7.3 Specific Subject Matter to Address

7.3.1 Modeling for an Engineering Audience

Clearly missing, is appropriate instruction for an engineer audience to enable them to describe their information needs in a way that is consistent with the definition of templates.

What is needed here is a course that provides guidance on the consistent description of each contributor's current approach to information definition - a way of defining reference data requirements.

These requirements can either be used within a company to feed into abstract reference data definition, or to directly contribute to substantiation for collaborative reference data development.

7.3.2 Modeling for Reference Data Developers

The current instructional documentation relating to methodology and development of templates is particularly weak,

relying on abstract description and with no solid work process.

Instructional support is needed in this area that allows cross-disciplinary subject matter experts to aggregate information needs and conceive reference data solutions. A robust and proven methodology is needed in order to generate consistent results.

7.3.3 Substantiation of Reference Data

Reference data, as it is currently made available, is missing clear linkage to any substantiation: examples, test data and use cases.

Instructional support together with process are needed to ensure that all reference data, from the point where it enters abstract design, is accompanied by such substantiation.

This is of vital importance: to the collaboration on reference data (so that contributors can understand its application); to the assessment of reference data (so that people can determine if it is fit-for-use); and to the consumption of reference data (so that people understand how to use it in the real world).

7.3.4 Business and Marketing Supports

Business and marketing audience segments need a range of materials, some of which are useful to other audience segments as well.

In particular there needs to be a well-articulated and agreed upon services road map, along with a supporting vision statement and other explanatory material. The lack of a roadmap per se is a huge barrier as things currently stand.

In association with that is collateral that justifies the return on investment in reference data by showing how it can be used effectively to avoid problems (through clarity of meaning) and lower costs (by reducing the number of discrete data integration projects).

7.3.5 Project Planning Supports

Currently, there is a lack of information that aggregates and summarizes the typical inputs into project planning as it relates to reference data.

IT Managers need to be able to quickly assess what the impact of relying on reference data services will be on their current operations (network technology and security especially). Material that summarizes the network behaviour of the reference data landscape in terms that support software integration would be greatly beneficial. They also need to be able to roughly scope the cost of that integration. They need to understand the level of service that the reference data system can provide, in order to evaluate risks to their internal workflows. No such material exists today.

Engineering managers and industry corporate divisions need to have a clear understanding of the amount of effort required to define and collaborate on reference data. Especially, this relates to:

- how much does it cost to train staff to collect requirements;
- how long does it take to develop their skills;
- what starting knowledge should they have;
- how does participation affect staff work loads and add external costs; and of course
- what information is required from their own companies for substantiation.

This is essential for evaluating the costs and the policy impacts of participation: for example, if test data comes from an ongoing capital project, a project manager needs to know to negotiate the use of that test data with their client, before passing it outside of the bounds of the contract and into a cross-industry collaborative environment.

7.3.6 Technology Offerings Support

There is a wide array of software companies within the ISO 15926 community, each eager to offer services. These companies face a range of recurring problems: a lack of clear definition around many aspects of the solution; no current guidance on data validation; no current service for interface conformance; awkward and unconventional approaches in certain aspects of the standards.

Many of these problems are well outside of the ambit of consulting, training and instruction. Most relate to the

operational policies of the organizational entity. Some relate to the definitions of parts of the standard per se.

However, once those operational policies and standards elements are in place, it would be necessary to provide guidance and support around their implementation. This would take the form of documents that clearly described:

- authorization model - how authorization extends with the transfer of data
- testing and conformance programme - how to test software interfaces; how to engage in conformance accreditation
- testing and validation programme - how to test data; how to prepare data for validation

Since the antecedents for these are currently lacking (though work is being done on them in the broader community), we can only scope the instructional deliverables in very approximate terms.

7.3.7 Formal Ontology Guidance

While Modeling for Reference Data Developers can provide some reasonable guidance for dealing with the way that templates relate to the core ontology, this doesn't provide guidance directly around the core ontology itself.

The core ontology, its development and its direct utilization are subjects largely intended for an research or academic audience as opposed to an industry-side audience. This audience is mostly self-sufficient in terms of instruction at the current time, but there is one very large gap.

That gap is analogous to the methodological gap around templates, but rather it is a methodological gap around direct modeling in the core ontology.

7.4 Design Principles

7.4.1 Priorities

The business model proposed 2014-04-18 suggests that we need to educate a large number of subject matter experts on how to identify their own information requirements. We also need to educate a smaller number of cross-disciplinary modelers on how to abstract and synthesize reference data from those requirements.

Since the business model is dependent on bringing maximum in-kind contribution to reference data definition, these two education initiatives have been made priorities in the design.

Because these are the two initiatives with the greatest cross-disciplinary and/or insulation requirements, they are also the ones that have been marked for conventional training delivery.

7.4.2 Remainder

The remainder of the requirements can likely be met with various self-service training delivery. That can be addressed with presentations, webinars, online surveys and tests, classical documentation and wikis. That supporting material needs to be scoped in this document.

In particular, these approaches for delivery are suitable to filling smaller gaps where the subject matter matches the areas of discipline of the audience segment.

8. Materials to Develop

This section lists the materials that need to be created by the consulting/training/instruction group before they will be able to author meaningful content for a course. These materials are needed to develop the courses, train trainers if need be, and will also be able to be used by trainees once they have completed some of the modules.

Incomplete: Right now, this only lists materials that are addressed by the courses listed below - the aggregate scores and analysis indicate that many more resources and/or engagements are required. The goal is to list them comprehensively in this section, and also add costing analyses.

8.1 Material: Templates and the Need for iRING and ISO 15926

DEVELOPMENT: 6 hours
SUBJECTS: Objectives and Templates.

This should be a simple document that lays out the basic need for iRING and ISO 15926 and how templates especially address that need. Probably a glossy brochure-style development.

The document should be oriented at the engineering, business and marketing audiences, with a particular focus on engineering staff and their management. The main points it should address are information interoperability (ISO 15926), reference data exchange (through iRING), and information requirements definition (by engineers).

Intended Audience/Criteria: Engineering, Business and Marketing.

8.2 Material: Template Schematic Language

DEVELOPMENT: 40 hours
SUBJECTS: Templates.

Describes a means of representing templates in some existing schematic language. This schematic language will be used for visual diagramming in training, using conventional industry diagramming tool solutions.

Intended Audience/Criteria: Engineering, Technology and Academia.

8.3 Material: Part2 Schematic Primer

DEVELOPMENT: 20 hours
SUBJECTS: Ontology.

A primer for the schematic language described in ISO 15926-2:2003. This is expected to be a quick reference for interpreting diagrams, not for creating such diagrams.

Intended Audience/Criteria: Technology and Academia.

8.4 Material: Services Roadmap

SUBJECTS: Road Map.

There are many missing elements of the overall reference data services solution as it currently exists. Appropriate instructional support is just one amongst many. A services roadmap has long been identified as needed to describe the path to addressing all of these gaps in the broader solution.

In practical terms, the roadmap will likely be generated not by the consulting, training and instruction team, or at least not alone: it will need to be driven and defined by senior management with engagement by the rest of the organizational entity and stakeholders.

Since the services roadmap represents a commitment by all of these parties, its not simple to define (if the results are to be both meaningful and persuasive).

Intended Audience/Criteria: Business and Marketing.

9. Courses to Develop

This section describes the courses, their modules, the audiences they serve and criteria they address, their dependencies and their required non-course specific material, their delivery method and some costing analyses for development.

9.1 Interpretation of Development Scope

The cost of developing training is well understood. As a rule of thumb, for conventional classroom style delivery that we're considering for the first two courses, the ratio is about 45 hours of development for an hour of instruction as it is currently conceived. Note that self-service instructional materials tend to cost more than this to develop (the presence of a trainer helps with interpretation of difficult material, so can bridge weaknesses in the material). Current funding is well short of this, so we do not expect the first module to meet the quality levels anticipated by the design.

9.2 Course: Reference Data Readiness

Course Delivery: conventional
Total Development: 540 hours
Total Duration: 12 hours

Reference Data Readiness is a course that is intended to create a pool of people with the skills and knowledge to generate reference data content for publication.

Trainees in the Reference Data Readiness course gain the skills to consistently analyze and communicate reference data needs, so that they can make shared reference data available in their capital projects.

Trainees in this course are not expected to become expert modelers at the core ontology level, which is considered a specialized discipline.

The course is principally constructed around conventional group training and intended to be delivered to an audience primarily from engineering and software backgrounds.

9.2.1 Module: Introduction to Templates

Development: 135 hours
Duration: 3 hours
New Material Dependencies:
Templates and the Need for iRING and ISO 15926 and Template Schematic Language.

A simple introduction to templates using supporting material developed to insulate the trainee from the deep structure of the full standard.

Structures the content around constraints: firstly, what templates minimally need, and secondly, what additional constraints the modeler will commonly apply.

Goal: The goal of the Introduction to Templates is to provide the trainee with the means to analyze and express information needs. While usable by technology professionals, it will be primarily targeted at engineers.

Intended Audience/Criteria: Engineering and Technology.

9.2.1.1 Topic: Templates and The Need for iRING and ISO 15926

The need for iRING and ISO 15926 should be clearly spelled out, with reference to how templates address that need. The content for this start to the module (and the course) should be consistent with the Templates and the Need for iRING and ISO 15926 document and can be shared with it.

9.2.1.2 Topic: Naming the Parts of Data

Taking an example engineering spreadsheet, this topic introduces basic terminology for talking about the shape of data and relating it back to the structure of the spreadsheet.

9.2.1.3 Topic: Implicit Information

Continuing with the spreadsheet example, this topic shows that there is a lot of implicit information in the spreadsheet, and emphasizes that this information is also important to capture.

9.2.1.4 Topic: The Shape of Information

Using the basic terminology from the first topic, this topic introduces a visual way of describing repeating patterns of information.

9.2.1.5 Topic: The Rules of Information

This topic takes the schematic a step further by showing how some simple constraints can be added to convey information that was implicit in the spreadsheet.

9.2.1.6 Topic: Identifiers and Scope

Introduces identifiers and the importance of context, especially scope and uniqueness and what all these mean. Lists some of the other aspects of context aside from scope, such as registry and format; and the special problems of information-bearing identifiers.

9.2.1.7 Topic: What Needs to be Captured

This topic lists all of the pieces of information that need to be captured, both implicit and explicit, from an information exchange such as a spreadsheet.

9.2.2 Module: Classes and Instances

DEVELOPMENT: 135 hours
DURATION: 3 hours
NEW MATERIAL DEPENDENCIES: Template Schematic Language.
MODULE DEPENDENCIES: Introduction to Templates.

Using the schematic example from "Introduction to Templates", this module seeks to ensure that the trainee gains an understanding of the difference between discrete things (instances) and types of things (classes), as well as kinds of types of things (classes of class).

GOAL: The goal of the Class and Instances is to lift the trainee from being able to analyze and express information needs, to being able to design narrow reference data solutions.

Intended Audience/Criteria: Engineering and Technology.

9.2.2.1 Topic: Types of Thing

Continuing with the same spreadsheet, this topic introduces the concepts of class, instance and literal and teaches how to distinguish them.

9.2.2.2 Topic: Relating Instances and Types

Deals with instantiation and type, contrasts it with sub classing and introduces a few rules of thumb deciding which approach to take. Uses the schematic to communicate the concepts.

9.2.2.3 Topic: Values, Representations and Units

Touches on literals, how they are different from their representations and their use in constructions such as measurements. An introduction is made to the concept of units (of measure) with a hint at their complexity, especially with respect to implicit information.

9.2.2.4 Topic: Relationships as Things

Introduces the concept of reification: what it is and a simple way to reach an alternative. This will rely on the schematic visuals to help communicate the message.

9.2.2.5 Topic: Tree of Types

Summarizes the course by presenting a "tree of types" and briefly iterating their defining features.

9.2.3 Module: Patterns of Templates

DEVELOPMENT: 135 hours
DURATION: 3 hours
NEW MATERIAL DEPENDENCIES: Template Schematic Language.
MODULE DEPENDENCIES: Introduction to Templates and Classes and Instances.

Building on the work in "Introduction to Templates", and "Classes and Instances", this module introduces a new level of abstraction with patterns of templates.

GOAL: The goal of the Patterns of Templates is to lift the trainee from being able to design narrow reference data solutions, to being able to abstract reference data solutions across multiple usages with short-term availability.

Intended Audience/Criteria: Engineering and Technology.

9.2.4 Module: Templates and Time

DEVELOPMENT: 135 hours
DURATION: 3 hours
NEW MATERIAL DEPENDENCIES: Template Schematic Language and Part2 Schematic Primer.
MODULE DEPENDENCIES: Introduction to Templates and Classes and Instances.

Building on the work in "Introduction to Templates", this module introduces a new level of abstraction that deals with time, how the core standard does it and how that bubbles up to templates, what needs to be dealt with to ensure that it all hangs together.

GOAL: The goal of the Templates and Time is to lift the trainee from simple discipline-specific abstraction up to being able to express information

requirements for multiple disciplines with explicit accounting for changes in the subject over its life-cycle.

Intended Audience/Criteria: Engineering, Technology and Academia.

9.3 Course: Ontology and Cohesion

Course Delivery: conventional
Total Development: 675 hours
Total Duration: 15 hours

The Ontology and Cohesion course is intended to train core data modelers, capable of working with the ISO 15926 part 2 ontology to create highly durable, logically cohesive definitions with part 7, for reference data publication.

Ideally, by the end of the course, these core data modelers will be familiar with not only the binary relationships of part 2, but also the n-ary relationships of part 7 and their application by non-specialist staff to create reference data.

Goal: Familiarity with both part 2 and part 7 will allow such modelers to create strong part 7 definitions, with logically consistent and aggregately cohesive decompositions into part 2 that satisfy the long-term needs of capital industry.

9.3.1 Module: Introduction to Ontology

Development: 135 hours
Duration: 3 hours
New Material Dependencies: Part2 Schematic Primer.
Module Dependencies: Classes and Instances.

Introduction to Ontology will provide trainees with a basic understanding of ISO 15926 part 2 - the key concepts and the distinct behaviour and constraints.

Intended Audience/Criteria: Technology and Academia.

9.3.2 Module: Ontology and Time

Development: 135 hours
Duration: 3 hours
Module Dependencies: Introduction to Ontology.

This module builds on the "Introduction to Ontology" by introducing time and its treatment in ISO 15926 part 2. Special attention will be focused on what things can retain identity and change, what things cannot and why.

Intended Audience/Criteria: Technology and Academia.

9.3.3 Module: Template Decomposition

Development: 135 hours
Duration: 3 hours
Module Dependencies: Ontology and Time and Templates and Time.

This module builds on the "Ontology and Time" module by expanding on exactly how part 7 templates can be fully expanded into part 2 and the ramifications of a part 7 encapsulation of such binary relationships.

Intended Audience/Criteria: Technology and Academia.

9.3.4 Module: Templates and Time 2

Development: 135 hours
Duration: 3 hours
Module Dependencies: Template Decomposition and Ontology and Time.

This module builds on the "Template Decomposition" module by going deeper into how part 7 templates interact with the modeling of change over time in part 2.

Goal: By referencing the lessons learned in the "Template Decomposition" and "Ontology and Time" modules, the trainee will understand the constraints of well-behaved part 7 definitions and be able to identify high-risk elements of template definitions and the their decompositions.

Intended Audience/Criteria: Technology and Academia.

9.3.5 Module: Durable Templates

Development: 135 hours
Duration: 3 hours
Module Dependencies: Templates and Time 2.

Durable Templates will step trainees through the pitfalls in designing durable, cohesive templates.

Goal: The goal of Durable Templates is to bring trainees up to the acme of ISO 15926 data modeling expertise: able to analyze data requirements expressed by others and to create solid, logically-cohesive and temporally-stable solutions at the part 7 level with part 2 building blocks.

Intended Audience/Criteria: Technology and Academia.

9.4 Course: Technical Integration of ISO15926

Course Delivery: Self-Service
Total Development: 1500 hours
Total Duration: 15 hours

"Technical Integration of ISO 15926" is intended to train technology professionals, especially software developers and integrators, firstly in how to integrate ISO 15926 reference data into their products and system landscapes, and secondly in how to move their landscapes towards ISO 15926 data.

Reference data and data are two different levels of integration technically — if the course modules expand beyond the current five, or delivery duration gets longer, consider splitting into two separate courses.

This course will be a self-service course, delivered with some simple browser-based skill assessment. This increases the cost of creating the course materials, but lowers the cost of delivery.

By the end of the course, the trainee should understand how to: choose and connect toolsets; assess the risks and costs of integration; as well as have concrete knowledge about data formats and protocols; how the discrete parts of these relate to generalized representations and change control in ISO 15926.

Goal: Produce technology personnel with the requisite skills and familiarity with ISO 15926 and iRING technologies in order to create and integrate software relating to reference data.

9.4.1 Module: Technical Overview

Development: 200 hours
Duration: 2 hours

Provide a technical overview of everything that is involved in bring ISO 15926 reference data to the trainees organization at the level of software and integration.

Topics are expected to include: the conceptual layers of ISO 15926; how these relate to ontology and formal logics; the difference with other ways of looking at information (relational database design, object-oriented languages, federated languages); the relationship to functional languages (and why this is important with respect to proofing and data validation).

The module should also connect with: information describing typical toolsets available for common software development platforms; and information describing typical integration costs and caveats. These external resources should be summarized in the module.

Note: need to add these resources to materials section above.

9.4.2 Module: ISO 15926 and RDF Representation and Query

Development: 300 hours
Duration: 3 hours

This module goes into the specifics of how reference data is stored in the PCA RDL and other services in RDF representations (possibly multiple), and then queried with SPARQL.

Loosely expected topics: introduction to RDF, N3 and XML (use N3 for course though), how ISO 15926 looks in N3, how N3 relates to SPARQL, extracting data with SPARQL, common queries for data extraction and tool integration.

9.4.3 Module: Integrating ISO 15926 Reference Data

Development: 300 hours
Duration: 3 hours

Expand on how reference data can be integrated into software and system landscapes. Specifically deal with identifiers and management, federated queries, caching (what to cache and why, how long to cache it for, what can change, how to deal with change).

Follow up with object oriented and federated language representations, how identifiers and naming affect things like type/class and field/method generation, where that introduces versioning risks for software and typical binding layer generation and management tools.

Finish with a synopsis on how deep the reference data goes into the conceptual model, and what that leaves out if we stop integration at the reference data and do not proceed to full data-level integration.

9.4.4 Module: ISO 15926 and Network Protocols

Development: 400 hours
Duration: 4 hours

This module is intended to be a thorough exploration of the framework provided by part 9. This will address SOAP/WS and its relationship to part 9, and how this enables data exchange with integrated

change management.

This should also detail change controls, the authentication and authorization models, how federated queries relate to the location of content, how change is reflected in the representation and so forth.

9.4.5 Module: Integrating ISO 15926 Data

DEVELOPMENT: 300 hours
DURATION: 3 hours

The final module in this course should address the practical challenges of integrating with ISO 15926 at the data level: rolling out ISO 15926 across a system landscape or project.

Specifically, this needs to address round-trip data loss: measures that can be taken to avoid it altogether; measures that can be taken to reintegrate data properly when it is unavoidable; and how these measures affect conformance (presupposes conformance is well defined).

Glossary

course

A systematically organized set of instructional modules.

description logics

A family of mathematical logics that are generally less rigid and somewhat richer than first-order logic (for the purposes of this document). OWL is based on description logics.

first-order logic

A type of mathematical logic (based on propositional logic through predicate logic). Most programming languages are implicitly founded on first-order logic. Contrast with description logics.

module

A single human instructional engagement with specific goals and outcomes. Part of a course, a module is expected to be about one to three hours in length for conventional training delivery. Modules are further divided into topics, in those cases where we have that level of design completed.

reference data

Data that describes the shape and meaning of other data.

source material

Refers to existing material (typically documents) that can be used either as the focus of, or in preparation of, some consulting, training or instructional goal.

subject area

A set of broadly related instructional subject matter. In this document, each subject area is divided into separate subject matter entries.

subject matter

Some focus of knowledge relating to consulting, training and instruction. Source material, material to be developed and course modules all address subject matter in these terms.

template

In ISO/TS 15926-7:2011, template refers to a specific kind of organization of information. A template instance is conceptually similar to a database record or a spreadsheet row. A template definition describes what the corresponding columns mean and how they are constrained. Templates in this sense are analogous to n-ary or finitary relations in mathematics and formal data modeling.

Template definitions may also express a full expansion into ISO 15926-2:2003 binary relations. For training purposes we will call this "decomposition", though the standard currently uses other terminology.

Change History

Reverse chronology of changes between releases of this document.

2014-06-30: Final Release

Fixes to internal links, spelling consistency and removal of internal directives and commentary. Revisions and notes on some scoring choices. Technology-oriented course added and provided with module level detail.

2014-06-02: Fourth Release to Stakeholder Representatives

Expansion and refinement of the "Executive Summary", thanks to very valuable stakeholder representative and advisor input. One of the main differences is that it has been made clear that computer-aided engineering technology personnel are intended to be addressed as part of the "engineering" audience (and in practice will probably make up the bulk of it), as opposed to the "technology" audience, which is more about commercial/enterprise software development staff. This message, and similar refinements for other audiences, have been carried through to the audience descriptions in section 3.

In 9.3, A self-service course has been added for technology professionals concerning the application of ISO15926 especially with regard to parts 7, 8 and 9 (and possibly 12) - like 9.2 (Ontology and Cohesion), this has only been fleshed out to the module level (no topics yet).

Minor spelling/grammar corrections have been made throughout the document. Material costs have been added where they are specific deliverables for consulting, training and instruction.

2014-05-26: Third Release to Stakeholder Representatives

Added the "Executive Summary" right underneath the Introduction, just left of the much larger "Contents" section.

Added web services references (not assessed yet). Several minor corrections and rephrasings; an extension to section 6.3 describing the gaps for direct consumers of the core ontology;

The table of contents now goes several levels deep rather than just listing the main section headings. A number of minor typographic layout and content linking changes. Moved the [summary] notation guidance again.

2014-05-19: Second Release to Stakeholder Representatives

The largest changes since the last release (2014-05-12) are that specific topics have been added to the module breakdowns (course structure). Section 6.3. "Specific Subject Matter to Address" has been inserted to the analysis and design section - this clarifies some of the rationale for the course and material choices made in the latter sections.

Refinements to introduction to subject matter score chart (5.3). Moved the [summary] notation definition to a more appropriate place (8.2). 6.4. "Design Principles" greatly expanded. 8.1 "Interpretation of Development Scope" added. New material "Templates and the Need for iRING and ISO 15926" added. Refinements to glossary section. Changes section added.

2014-05-12: First Release to Stakeholder Representatives

This release fills out the design document with a lot of introductory, bridging and linking material, rather than just present

as a list of categories and data points.

Significant changes from the previous version include more consistency with conventional training-specific terminology. There is also the addition of a chart useful for gap analysis that shows where an audience segment need has been identified against specific subject matter, but source material is not currently available.

2014-05-02: Second Design Review

Initial course segmentation and module definition.

2014-04-22: First Design Review

Takes the previous material catalogue and scoring document and expands it into a training program design skeleton.

2014-03-25: Analysis Review

The earliest distributed form of the content collecting material catalogue, scoring and audience segmentation for analysis and discussion.

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