Moving Oil & Gas Industry Standards from Prose to Data

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INCOSE Oil & Gas Workgroup: Standards Committee

- Robert Perry, Chair *(TechnipFMC)*
- Robert McAfoos, Co Chair *(Barrios)*
- Abe Hudson *(Barrios)*
- Jason Baker *(Transocean)*
- John Daniel Friedemann *(GE)*
- Kerry Stout *(TechnipFMC)*
- Kiran Krishna *(Shell)*
Objective

- Influence standards bodies (API, ISO, ASTM, etc.) to modify the format and structure of their requirements documents to separately identify:
  - The requirement (shall statement)
  - Rationale or history
  - Verification
Why Systems Engineering?

Systems Engineering improves complex system project performance:
• More high performing projects
• Less train wrecks

SE identifies busts early, rather than late:
• Earlier issue detection is considerably less costly to remedy

Source: Elm & Goldenson
What is Systems Engineering?

Rigorous System Engineering:

Business Objective
System Configurations
Product Configurations
Components

Manufacture

Verify components, products & systems meet requirements

Validate the business objective is met

Operate & Maintain
Abandon

Requirements are the backbone to Systems Engineering…
Requirements Universe

Standards & Codes make up some requirements:

- Standards
- Operators
- Regulators
- Service Companies
- Sub Suppliers
Requirements: Spot the Requirement

• Example:

MACHINE ALARM AND SHUTDOWN FUNCTIONS

Machine safeguarding shutdown functions ("trips") are required on rotating equipment to prevent serious failures resulting in potential hazards to personnel or the environment or in extended process unit downtime. All machine trips require a pre-alarm prior to a shutdown in order to give Operations a chance to take action to prevent a trip.

Shutdown function design shall be based on an SIL Assessment, shall comply with this standard and shall take into consideration the recommendations of the original equipment Manufacturer (OEM).

The methodology specified in this standard is intended to avoid unnecessary machine trips. The related Informative shows sample trip voting and instrument redundancy that avoids unnecessary trips based on a generic SIL analysis. In some processes it is safer to keep the machine running in order to carry out an orderly process shutdown. In these cases, the shutdown system should be sequenced to do so automatically so that the process is returned to a safe situation before the machine is shut down.

API Std 670 has traditionally required relays be used as the output from the machinery protection rack to the IPS, and that voting be carried out in the machinery protection rack. This approach may limit flexibility in the IPS implementation for some applications. As an alternative approach, 4-20 mA outputs on the machinery protection rack may be directed to the IPS where voting and other logic can be implemented in that system. However, either relays or 4-20 mA signals are satisfactory input to the IPS. If relays are used, the most configurable relay system available should be selected in order that flexibility in the design of voting logic is available. Care should be taken to assure that NOT OK and BYPASS conditions are considered when voting in the IPS, either with relays or 4-20 mA outputs. By choosing to vote in the IPS instead of in the machine protection rack, some desired functionality around OK and BYPASS conditions that are part of the machine protection rack design may be overridden in the IPS. This functionality will then have to be included in...
### Requirements: Spot the Requirement

- **Example:**

<table>
<thead>
<tr>
<th>Content</th>
<th>Requirement Type</th>
<th>Informative Text</th>
<th>Selection</th>
<th>Selection Rationale</th>
</tr>
</thead>
</table>
| **MACHINE ALARM AND SHUTDOWN FUNCTIONS**

Machine safeguarding shutdown functions ("trips") are required on rotating equipment to prevent serious failures resulting in potential hazards to personnel or the environment or in extended process unit downtime.  

All machine trips shall be provided with a pre-alarm prior to a shutdown to allow Operations sufficient time (typically minimum 15 minutes) to take action to prevent a trip.

Shutdown function design shall be based on an SIL Assessment.

Shutdown function design shall incorporate the recommendations of the original equipment Manufacturer (OEM).

In cases where it is safer to keep the machine running to allow a process shutdown, the shutdown system should be sequenced to do so automatically so that the process is returned to a safe situation before the shutdown.

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</table>

Requirements as data in a database allows users to:
- segment data,
- classify data,
- select data,
- annotate data,
- attribute data,
- filter data,
- etc.
Requirements: Vision

- Requirements (example format)

<table>
<thead>
<tr>
<th>#</th>
<th>Subject</th>
<th>Verb</th>
<th>Requirement</th>
<th>Condition(s)</th>
<th>Verification</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The system</td>
<td>shall</td>
<td>contain a pressure of 10,000psi</td>
<td>when installed in the operating environment</td>
<td>Verified by….</td>
<td>Because….</td>
</tr>
</tbody>
</table>

**Good Requirement:**
Identifier, Necessary, Implementation independent, Unambiguous, Complete, Singular, Achievable, Verifiable, Conforming, Complete, Consistent, Feasible and Affordable, Bounded

- Vision:
  - Standards bodies provide requirements to oil and gas industry in data format (ReqIF/XML) rather than PDF’s and prose
  - Updates and revisions are traceable to a specific requirement
Overall Project Approach

- Identify which standards, codes and organizations are most relevant:
  - API was identified as the most leveraging organization to start

Project plan:
- Approach API to provide rationale and project proposal
- Undertake a pilot with API on a single relevant standard
- Learn from pilot and roll out further:
  - to other API standards
  - to other standards and codes organizations
API Pilot Project Approach

- Discuss with API our vision and obtain broad support
- Identify one API document entering the ballot phase where the chair is open to the new approach (API 17X)
- Brief and obtain support from member companies that have voting members for that document
- Send formal request to API
- Approval to proceed from API
  - Contracts in place with API
  - Provide requirements training / coaching to the voting members for that document
  - Provide requirements authoring assistance to the committee chair
  - Develop in parallel
    - Database “document” with requirement attributes (ReqIF / XML)
    - Database driven MS Word / PDF requirements document
    - Compare against traditional API style prose document
API Pilot Timeline

1Q17

Traditional API document & workflow

Engage API

Engage working committee API 17X

Agree contracts

API Approval

Contracts in place

2Q17

Work with authors to create: database & ‘prose from data’ products

Training

Draft Database & Document

3Q17

Work through commercial implications with API of how standards as data gets used

Ballot

4Q17

Review pilot results
API Pilot Project Considerations

- Run pilot in parallel with usual API process for creating a standard
- Conversion from prose to requirements data: there needs to be content specific alignment discussions – this is not a simple translation function:
  - relevant stakeholders need to be engaged on content as we go
- Consistent prose & data formats: there will continue to be a near term mix of standards customers needing prose and/or data standards:
  - consistency between prose and database will be critical: create a database and a prose document derived from the database
- Commercial implications for standards and codes as data: need to consider for how standards are distributed and used (commercial models, Intellectual Property protection etc):
  - in parallel with creating the work products, also work through the commercial implications
Content Alignment:
API document to Database Products

Traditional API Prose Workflow

Prose content changes → Align → Prose content changes

Feb 19 Prose and Database w/ 17X

Pilot API Database Workflow

Database content changes → Align → Database content changes

Etc…
Prose Document Derived from Database

- Formatting and ‘joining up’ (conjunction) text to make the database read like a document

Systems Thinking Round Table
Saturday, Jan. 4, 2017, “Systems Thinking Round Table”, will be from 7:00:00 AM to 8:00:00 AM. This session is a/an Open/Working session discussing the following:

An open forum round table discussing relevant ideas.

Opening plenary
Saturday, Jan. 4, 2017, “Opening plenary”, will be from 8:00:00 AM to 10:00:00 AM. This session is a/an Open session discussing the following:

Opening Plenary of the International Workshop

Human Systems Integration
Saturday, Jan. 4, 2017, “Human Systems Integration”, will be from 10:00:00 AM to 12:00:00 PM. This session is a/an Open/Working session discussing the following:

a series of the HIS Working Group meetings will be held at IW 2017. Objectives are to further discuss the changes in HSI approaches, and suggest change write ups in both SE BOK and SE Handbook. They will follow up the INCOSE HSI workshop that was held at Finida Tech on October 4-5, 2016.

Systems Security Engineering
Sunday, Jan. 5, 2017, “Systems Security Engineering”, will be from 9:00:00 AM to 5:00:00 PM. This session is a/an Open/Working session discussing the following:

Systems Security Engineering working group all day workshop. Review work done, work in process, and consider work to do.
Commercial Implications for Standards as Data

Potential considerations could be:

• Sales and Distribution: Selling and distributing data versus full documents

• Retaining Ownership Control: Intellectual property considerations, derivative works, etc

• etc
API Pilot Timeline

1Q17

- Traditional API document & workflow

2Q17

- Engage API
- API Approval
- Engage working committee API 17X
- Agree contracts
- Contracts in place

3Q17

- Work with authors to create: database & prose from data products
- Training
- Draft Database & Document
- Ballot
- Work through commercial implications with API of how standards as data gets used

4Q17

- Review pilot results
Moving Oil & Gas Industry Standards from Prose to Data

Thank You...

...Questions?