Standardising Standards-based Interoperability: The Architecture of the OIIE and OGI Pilot

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University of South Australia

June 4, 2019
NIST Open Industrial Digital Ecosystem Summit
AI and Software Engineering Group

• About 20 people
• AI + Software Engineering + Data Management
• Major topics
  • Modelling and reasoning about system behaviour
  • Diagnostics, Configuration, Automated Debugging, Natural Language
  • Information and knowledge management in distributed ecosystems
Projects in the Ecosystem Space

• OT/IT Interoperability
• Digital Information Energy Australia Gateway
• OGI Pilot - OIIIE
• Genetic Data Curation
• SOA for Future Combat Systems
• Automated Modelling for Combat Simulation Ecosystems
• Integrated Law Enforcement – Federated Data Platform
What is the OIIE?

- Open Industrial Interoperability Ecosystem
- Framework and architecture for defining and describing standardised and standards-based ways for how systems should interoperate
- Aims to support Digitalization, Supplier-neutral, and enable COTS & Open Source Plug ‘n Play Interoperability
- Refinement of concepts MIMOSA has been developing for ~15 years
- Includes several components:
  - Use Case Architecture
  - Connectivity and Services Architecture
  - Data and Message Models
  - Specifications for systems supporting Ecosystem Administration, e.g:
    - ws-ISBM, SDAIR, CIR, Services Registry
Major suppliers of IT Infrastructure and Industrial Applications and Systems all want their ecosystem to be THE Ecosystem.
What is the OGI Pilot?

▪ Test-bed and proving ground for the OIIIE
▪ Where we try to make the OIIIE a reality
▪ Previous pilots phases focused on EPC → O&M Handover of As-Designed Engineering Data (P&IDs, etc.)
▪ Current pilot phase covers 2 additional major aspects:
  ➢ Requests for model information relating to requirements (greenfield) and/or incomplete asset data (brownfield)
  ➢ Condition-based Maintenance
▪ Possible areas for future pilot phases:
  ➢ Coverage of process design (PFDs)
  ➢ Expand Capital Projects Use Cases, full Procurement
  ➢ CBO (Condition Based Operations)
Full Asset Life-cycle Management

- Product Design
- Product MFG
- Process Engineer
  - Simulate
- Engineer Design
- Procure
- Construct
- Operate & Maintain (O&M)
- Continuous Improvement Feedback Loops
- End of Life

Device/Equip Manufacturing

Platform Integrator
- Capital Project

Owner/Operators

Product Model/Product=Component/Systems(Packages)/System of Systems/Plant/Facility/Platform Life-Cycles

Derived from ISO TC 184 Manufacturing Asset Management Integration Task Force Final Report

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Standard OII/OGI Use Cases

Cross Project Activities

Capital Projects

Complete/Commission/Startup

Operate/Maintain

Decommission/Dispose

Opportunistic Handover of Structured Digital Assets

Sustained Life-cycle Digital Asset Management

OIIE Use Case 1: Information handovers to O&M

OIIE Use Case 2: Recurring Engineering Updates to O & M

OIIE Use Case 3: Field Changes to Plant/Facility engineering

OIIE Use Case 4: Enterprise Product Data Library Management (tied to ISDDs)

OIIE Use Case 5: Asset Installation/Removal Updates

OIIE Use Case 6: Preventive Maintenance Triggering

OIIE Use Case 7: Condition Based Maintenance Triggering

OIIE Use Case 8: Early Warning Notifications

OIIE Use Case 9: Incident Management/Accountability

OIIE Use Case 10: Automated Provisioning of O & M systems

OIIE Use Case 11: Enterprise RDL Management

OIIE Use Case 12: RFI and RFI Response (Models Meeting Requirements and Model Information, Green and Brown Field)

OIIE Use Case 13: Lockout/Tagout

OIIE Use Case 14: CBM Data Acquisition

OIIE Use Case 15: Capital Project Asset Install

Yellow Use Cases in Phase 3.1
Components of the OIIE

*Use Case Architecture
Connectivity and Services Architecture
Data and Message Models (CCOM, ISDDs, OAGIS BOD Architecture, etc.)
Specifications for Ecosystem Administration systems
OIIE/OGI Standardized Use Case Architecture
Standardized Methodology to Define and Re-use OIIE Components

- Use Cases
  - Background
  - Scope
  - Preconditions
  - Successful End Condition
  - Actors
  - Triggers
  - Process Workflows
  - Scenarios

- Scenarios
  - Actors
  - Data Content
  - Data Formats
  - Reference Data
  - Information Service Bus Configuration
  - (OIIE) Events

- (OIIE) Events
  - Individual Message Exchange
  - Specific Data Content
  - Required Data Processing
  - Expected Response Event
  - Reference implementation using CCOM BODS

User Stories
- High-level
- Pictographic
- Depict 1 or more Use Cases, Scenarios, and/or Events
- Actors, Systems, Exchanges, Data

User Stories
 Definitions in Brief

- **Use Case**
  - general description of interactions to achieve an interoperability goal within a specified scope and background context

- **Scenario**
  - specific description of a group of events that achieve an interaction detailing data and configuration requirements; multiple scenarios may be required to achieve the goal of a use case and the same scenario may be reused by multiple use cases
Definitions in Brief

- **Event**
  - individual message exchange between systems detailing data and processing requirements

- **User Story**
  - high-level graphical representation of interactions and events defined by one or more use cases and/or scenarios
UC-5: Asset Installation/Removal Updates (Abridged)

Overview
This Use Case describes the process for updating O&M systems of serialized asset configuration updates. The updates originate from a Work Management System (WMS) and may include verification against sensed install/removes originating from an Intelligent Automation Bus (IAB).

Background
One of the largest headaches for any complex facility or plant is keeping accurate track if serialized assets currently installed in a given functional location. Experience has shown that substantial process and information gaps routinely exist and there are often substantial gaps after a few years of operating.
UC-5: Asset Installation/Removal Updates (Abridged)

Scope
The scope of this Use Case is limited to remove and replace corrective maintenance.

[NOTE: The reuse aspects of the Use Case Architecture mean that the Scenarios and Events (and their implementations) are reused in other Use Cases, such as Capital Project Asset Installation]

Preconditions
Information Handover to O&M and O&M Provisioning must have occurred prior to this Use Case so that the WMS, IAB, and other O&M systems are populated with functional location and asset information.
UC-5: Asset Installation/Removal Updates (Abridged)

Successful End Condition
A reconciled, completed work order for asset removal/installation has been published to any interested O&M systems.

Actors

Business Actors:
- Operations; Maintenance Planner; Technician

System Actors:
- Maintenance/Work Management System; I&C Device Monitoring System (IAB)
Triggers
Operations sends a work request to Maintenance identifying a particular plant item that needs maintenance.

Main Success Scenario

<table>
<thead>
<tr>
<th>Send work request</th>
<th>Operations sends a work request to Maintenance identifying a particular plant item that needs maintenance.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generate and approve work order and schedule</td>
<td>The Maintenance Planner generates a work order and schedule in the Maintenance Management System against a functional location or asset. The work order is given approval by Operations.</td>
</tr>
</tbody>
</table>

(see next slide)
UC-5: Asset Installation/Removal Updates Example Workflow

Use Case 5 – Asset Installation/Removal Updates

Operations
- Maintenance required
  - Send work request identifying asset or functional location
  - Approve work order and schedule
  - Organize resources and hand off work order
  - Generate work order and schedule
  - Create work order
  - Approve work order and schedule
  - Organize resources and hand off work order
  - Remove old serialized asset from functional location
  - Record removal
  - Record install
  - Reconcile asset install
  - Sign off work order

Maintenance Planner
- Generate work order and schedule
- Approve work order and schedule
- Organize resources and hand off work order
- Remove old serialized asset from functional location
- Record removal
- Record install
- Reconcile asset install
- Sign off work order

Technician
- Create work order
- Approve work order and schedule
- Organize resources and hand off work order
- Remove old serialized asset from functional location
- Record removal
- Record install
- Reconcile asset install
- Sign off work order

Maintenance Management System
- Create work order
- Approve work order and schedule
- Organize resources and hand off work order
- Remove old serialized asset from functional location
- Record removal
- Record install
- Reconcile asset install
- Sign off work order

I&C Device Monitoring System
- Create work order
- Approve work order and schedule
- Organize resources and hand off work order
- Remove old serialized asset from functional location
- Record removal
- Record install
- Reconcile asset install
- Sign off work order

Scenario 10
- SyncAssetSegmentEvents
- SyncAssetSegmentEvents
- SyncAssetSegmentEvents

Scenario 11
- SyncAssetSegmentEvents
- SyncAssetSegmentEvents
- SyncAssetSegmentEvents

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UC-5: Asset Installation/Removal Updates (Abridged)

System Interoperability Scenarios

- Scenario 10 – Push Intelligent Device Removal/Installation Events from CMS to MMS
- Scenario 11 – Publish Asset Removal/Installation Events from MMS to O&M

Version Applicability/Alignment

[indicates with which version of CCOM and/or other specifications the Use Case is compatible]

Document Versioning

[Table of major revisions, dates, and the major changes.]
SC-10: Push Intelligent Device Removal/Installation Events from CMS to MMS (Abridged)

Overview

This Scenario details an Intelligent Automation Bus system sensing an asset removal/installation at a functional location and notifying another OIIE enabled system, such as a Work Management System being used for maintenance work orders.

[Note: Here ‘event(s)’ refers to the AssetSegmentEvent element of CCOM]

Actors

[system actors only in Scenarios]

<table>
<thead>
<tr>
<th>IAB System</th>
<th>Notify OIIE Systems of changes in asset configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Management System</td>
<td>Receive notifications from IAB System of changes in asset configuration. Associate asset removal/installation with work order.</td>
</tr>
</tbody>
</table>
SC-10: Push Intelligent Device Removal/Installation Events from CMS to MMS (Abridged)

Data Content

The data sent from the IAB to the WMS is at least:

- Functional location; serialized asset; timestamp when install/remove occurred

Additional contextual data may be sent:

- Agent performing the work; calendared maintenance work order

MIMOSA CCOM Reference Types

[lists general types and relevant specific reference data that is to be used]

- ‘Installation of Asset on Segment’ EventType,
  UUID: ecc99353-412b-4995-bd71-1cbc6fc16c7c

- ‘Removal of Asset on Segment’ Event Type,
  UUID: 3a45e126-b234-42a0-b3b1-07c29522d02d
SC-10: Push Intelligent Device Removal/Installation Events from CMS to MMS (Abridged)

Data Formats

[Indicates any constraints on specific data formats]

The data published by the IAB System and received by the Work Management System must conform to MIMOSA CCOM BODs.

[Note: Does not specify which BODs; the Events determine that.]

System Interoperability Events

- Push Asset Segment Event Data
  - This maps to a request-response BOD pair: ProcessAssetSegmentEvents, AcknowledgeAssetSegmentEvents

[there may be several events, but only 1 in this Scenario]
SC-10: Push Intelligent Device Removal/Installation Events from CMS to MMS (Abridged)

Infrastructural Components

[includes requirements based around the use of specific OIIE components such as the ISBM, SDAIR, Transform Engine, CIR, etc.]

ISBM

The communication between all systems occurs via the ISBM using request-response services.

Implementation Requirements

▪ The IAB System must implement a client for the Consumer Request and Channel Management (GetChannel operation only) Services
▪ The Work Management System must implement a client for the Provider Request and Channel Management (GetChannel operation only) Services
▪ Both systems may implement a client for the Notification Services
SC-10: Push Intelligent Device Removal/Installation Events from CMS to MMS (Abridged)

*Suggested Channel/Topic Configuration*

Channels and topics should be declared following the ISBM Guidelines.

Example channel path:

/Enterprise/Refinery A/Area A/Light Ends Area/ISO18435:D1.3

Example Topic Name:

OIIE:S10:V1.1/CCOM-XML:ProcessAssetSegmentEvents:V1.0

*Event Sequence*  
(see next slide)
SC-11: Publish Asset Removal/Installation events from MMS to O&M (Abridged)

Overview

In order to notify other O&M systems that a serialized asset has been installed or removed, the Work Management System (WMS) publishes an asset install or removal event to all relevant O&M systems.

Actors

[system actors only in Scenarios]

<table>
<thead>
<tr>
<th>Work Management System</th>
<th>Send notifications of changes in asset configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>O&amp;M Systems</td>
<td>Receive notifications of changes in asset configuration</td>
</tr>
</tbody>
</table>
SC-11: Publish Asset Removal/Installation events from MMS to O&M (Abridged)

Data Content
The data sent from the WMS to other O&M Systems is at least:
- Functional location; serialized asset; timestamp when install/remove occurred

Additional contextual data may be sent:
- Agent performing the work; calendared maintenance work order

MIMOSA CCOM Reference Types
- ‘Installation of Asset on Segment’ Event Type,
  UUID: ecc99353-412b-4995-bd71-1cbc6fc16c7c
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  UUID: 3a45e126-b234-42a0-b3b1-07c29522d02d
SC-11: Publish Asset Removal/Installation events from MMS to O&M (Abridged)

Data Formats

[Indicates any constraints on specific data formats]

The data published by the Work Management System and received by other O&M Systems must conform to MIMOSA CCOM BODs.

[Note: Does not specify which BODs; the Events determine that.]

System Interoperability Events

- Publish Asset Segment Event Data
  - This maps to a publish-subscribe BOD: SyncAssetSegmentEvents
SC-11: Publish Asset Removal/Installation events from MMS to O&M (Abridged)

Infrastructural Components

*ISBM*

The communication between all systems occurs via the ISBM using publish-subscribe services.

Implementation Requirements

- The Work Management System must implement a client for the Provider Publication and Channel Management (only the GetChannel operation) Services.

- O&M Systems must implement a client for the Consumer Publication and Channel Management (only the GetChannel operation) Services. O&M Systems may implement the ISBM Notify Listener Service for message notification.
SC-11: Publish Asset Removal/Installation events from MMS to O&M (Abridged)

Suggested Channel/Topic Configuration

Channels and topics should be declared following the ISBM Guidelines.

Example channel path:
/Enterprise/Refinery A/Area A/Light Ends Area/ISO18435:D1.3

Example Topic Name:
OIIIE:S11:V1.1/CCOM-XML:SyncAssetSegmentEvents:V1.0

Event Sequence
(see next slide)
SC-11: Publish Asset Removal/Installation events from MMS to O&M Event Sequence
1. We need to build a light ends unit to remove butane from our incoming crude supply.

2. a. How much capacity do we need?
   b. What will the incoming crude spec be?
1. We need to buy equipment and instruments meeting or exceeding functional requirements taken from PFD and P&IDs for the new Debutanizer Tower.

2. Send me the Requirements from those documents and I will check with our preferred suppliers.

3. P2M Dialog

Requirements (RFI)

Models Meeting Requirements (RFI Response)

Debutanizer PFD and P&ID

Client Engineering Person

Client Purchasing

Instrument or Equipment Supplier Portals

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Components of the OIIE

Use Case Architecture
*Connectivity and Services Architecture
Specifications for Ecosystem Administration systems
Data and Message Models (CCOM, ISDDs, OAGIS BOD Architecture, etc.)
OIIIE Inter-Enterprise Systems Connectivity and Services Architecture
Enabling Industry 4.0

Manufacturers
IT Networks
Automation and Control
Enterprise Business Systems

OEMs
Manufacturers
Enterprise Business Systems

PFD, P&ID, Tags, Docs & Requirements
Model and Instance Information
Functional and Technical Requirements

Owner/Operators
Enterprise Business Systems
IT Networks

Operations & Maintenance Data (Monitoring, Diagnostics Prognostics)
Manufactured Asset Data (Make/Model Information, Serial #)

EPC Firms
Engineering, Procurement and Construction

Business Requirements
IT Networks

Automation and Control
OIIE Intra-Enterprise Systems Connectivity and Services Architecture

Enterprise Business Systems

- OIIE Administration
- Planning
- Engineering Design
- Construction Management
- Operations Management
- Operations Risk Management
- Maintenance Management

IEC 62264 Messaging Service Model / OpenO&M Information Service Bus Model

Standard, Cloud Friendly Enterprise Solutions Architecture For Digital Business Ecosystems

Connectivity Legend

- IIoT Connections
- (Constrained)
- Trusted IT/OT connections
- ISBM Web Services (Constrained)

Automation Control Bus

- Automation and Control
- HSE and Operation Monitoring
- Prognostic & Health Management

IIOT Device

- Device
- Sensor/Transducer

Shared Information and Semantic Context

- Enterprise Reference Data Libraries IIoT Device Metadata
- Industry Reference Data Libraries IIoT Device Metadata (ISO 15926, OTD, CDD...)

Inter-Enterprise Connections

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Components of the OIIE

Use Case Architecture
Connectivity and Services Architecture
*Specifications for Ecosystem Administration systems
Data and Message Models (CCOM, ISDDs, OAGIS BOD Architecture, etc.)
OpenO&M ws-ISBM

- Backbone of the OIIE Architecture
- Web Service definitions (SOAP) for Enterprise Service Buses supporting request-response and publish-subscribe messaging modalities plus push notifications
- Interactions defined through web-services:
  - Channel Management Service: channel, security configuration
  - Notification Service: allow notifications of new messages
  - Provider Publication Service: publish messages
  - Consumer Publication Service: read published messages
  - Provider Request Service: read and respond to requests
  - Consumer Request Service: send requests and read responses
Typical Publish-Subscribe Interaction

Provider

OpenPublicationSession
Parameters: Channel, ...

PostPublication
Parameters: Topic(s), Message, ...

ExpirePublication
Parameters: Session, MessageID

ISBM instance

OpenSubscriptionSession
Parameters: Channel, Topic, ...

NotifyListener
Parameters: Session, Topic(s), ...

ReadPublication
Parameters: Session

Message Content

Consumer
Typical Publish-Subscribe Interaction

Provider

ClosePublicationSession
Parameters: Session

ISBM instance

RemovePublication
Parameters: Session

CloseSubscriptionSession
Parameters: Session

Consumer
Typical Request-Response Interaction

Consumer

OpenConsumerSession
Parameters: Channel, ListenerURL

PostRequest
Parameters: Topic, Message, ...

OpenProviderSession
Parameters: Channel, Topic(s), ...

ISBM instance

NotifyListener
Parameters: Session, Topic(s), ...

ReadRequest
Parameters: Session

Message Content

Provider

Processing

expireRequest
Parameters: Session, MessageID
Typical Request-Response Interaction

- **Consumer**
  - CloseConsumerSession
    - Parameters: Session
  - NotifyListener
    - Parameters: Session, Topic(s), ...
  - ReadResponse
    - Parameters: Session
  - Message Content

- **ISBM instance**
  - PostResponse
    - Parameters: RequestID, Message, ...
  - CloseSubscriptionSession
    - Parameters: Session

- **Provider**
  - RemoveRequest
    - Parameters: Session
  - PostResponse
OpenO&M ws-ISBM v1.1

- Currently updating the specification to version 1.1
- Major addition is a new RESTful interface with JSON support
- Improvements and generalisations to support mixed content and transparency between the SOAP/XML interface and a REST/JSON interface
- Clarification of security elements and their management
- Version 1.1 is being validated as part of the OGI Pilot
SDAIR: Structured Digital Asset Interoperability Register

- Provides several functions for an OIIIE:
  - Various aspects of OIIIE Configuration
  - Register and mapping of (multiple) Tag Identifiers to UUIDs to facilitate CCOM-based exchanges
  - Managing primary enterprise breakdown structure and associated OIIIE configuration: cross-domain
  - Managing ISDDs and their mappings
  - Register of assets, functional locations, breakdown structures, etc., as required to achieve OIIIE functionality, particularly for cross-domain data that no individual system can typically maintain

- Functional definition only: vendors can provide various implementations as long as they fulfil the requirements and conform to the OIIIE interfaces
OpenO&M CIR: Common Interoperability Register

- Provides mapping services between identifiers of different systems
- In contrast to SDAIR which provides more “internal” mappings, SDAIR provides more “external” mappings
- General example usage is to resolve against common reference data before exchanging a message, e.g.:
  - System A queries CIR for IDs according to specific reference data library
  - CIR responds with IDs matching the query
  - System A sends message to System B using CIR provided IDs
  - System B receives message and queries CIR for IDs related to its own systems
  - CIR responds with IDs matching the query
  - System B can then process its data in its own way
Services Register

- The Services Register supports the configuration and discoverability of systems and services in the OIIE
- Description of channel/topic configurations
- For example, consumers can query it for services publishing information of interest and then subscribe to those channels/topics
- Not used in the current Pilot but ultimately an integral part of the ecosystem administration
Components of the OIIE

Use Case Architecture
Connectivity and Services Architecture
Specifications for Ecosystem Administration systems
*Data and Message Models (CCOM, ISDDs, OAGIS BOD Architecture, etc.)
Message and Content Models

- Bring standards together that provide value and meet requirements:
  - MIMOSA CCOM—Asset Lifecycle Modelling
  - ISDDs (Industry Standard Datasheet Definitions)—Datasheet models for functional locations, models, and assets, based on:
    - API, ASME, IEC, ISA, ISO, NORSOK and PIP
  - OAGIS BOD Architecture—Message Model
  - ISO 13374—Condition Based Maintenance (incorporated into CCOM)
  - Reference Data from various sources: ISO 15926, ISA, ISO 14224, ...

- Placeholders for other standards at different levels, but currently focused on those above
Contextualization for Open Industrial Interoperability Ecosystem using MIMOSA CCOM 4.x, ISA, OAGi, ISO and IEC Standards

- **Process Engineering** -(CCOM Segment Networks) - Process Flow Diagrams
  - Work Processes followed for CAPEX and OPEX (Intra and Inter-Enterprise)
  - Production Process to be supported by Plant/Platform/Facility

- **Functional/Systems Engineering** -(CCOM Segment Networks) - P&IDs, other schema
  - System of Systems
  - Systems (Functional Packages)
  - Functional Locations (P&ID Tag)
  - Components
  - Sensors

- **Models** - (CCOM Model) – Used for MFG Model and Package Model

- **Serialized Equipment & Devices** -(CCOM Assets installed in CCOM Functional Locations)

- **Multiple Breakdown Structures as Needed** - Taxonomic views of same CCOM objects
  - Enterprise Breakdown – Enterprise/Area/Unit (ISA 95/88)
  - Maintenance Breakdown Structure - (e.g. ISO 14224)

- **ISDDs** - Property Sets for ALL Functional Locations, Equipment and Devices

- **IIOT** - Data captured by Sensors is Contextualized by ALL of Above
MIMOSA adopted OAGIS Business Object Document Architecture for structuring messages and defining the behaviour of encapsulated MIMOSA CCOM payloads.

- Allows consistent structure and metadata regardless of data format or protocol.
- Each BOD schema specifies criteria on message content used to implement OIIIE Events.
- Supported Verbs:
  - Get, Show, Sync, Process, Acknowledge, Confirm
  - Get/Show, Process/Acknowledge Request-Response
  - Sync Publish-Subscribe
CCOM BODs Conceptual Approach Example

*Request for Information*
Respond By = 2018-06-06

Request Type
Model Request for Asset

Asset
Serial No. = XYZ0001

Asset Installation Event
Installed At: 2017-06-06

Segment
Functional Location TS001

Functional Location (Segment: Functional Location TS001)
Asset Installation Date (2017-06-06)

Model Request (Request For Information)
From Agent (Agent: Owner/Operator)

Respond By (2018-06-06)

Asset (Asset: with S/N XYZ0001)
Serial Number (XYZ0001)

Functional Requirements (Attribute Set: ISDD Instance)
Group (Attribute Group)
Attribute (Attribute: Temp. Min. = -15°)
Attribute (Attribute: Temp. Max. = 90°)
Industry Standard Datasheet Definitions (ISDDs)

- Capture existing Industry Standard Datasheets as machine interpretable business objects to make them fully re-usable, mappable, and extensible.
  - Provide standard (XML) exchange schema for exchanging datasheet-oriented information
  - Mappable to existing OEM and O/O Datasheets

- Capture high-value properties from existing data sheets published by credible industry associations, such as:
  - API, ASME, IEC, ISA, ISO, NORSOK and PIP.

- Support Asset’s full life-cycle information management
  - Data sheets are not used just for procurement
  - Improves ability to procure, install, commission, operate and maintain assets with reduced effort, cost and schedule
Types of Data Sheet

- **Functional Segments** can be associated with data sheets to specify functional requirements.
- **Models** can be associated with data sheets to specify characteristics of equipment of that model.
- **Equipment Assets** can be associated with data sheets to specify characteristics of that equipment.
- **Segment and Asset Types** can have data sheet templates to support class libraries.
ISDD Example Instance

ISA 20T2221 Datasheet

Property Group
RESponsible Organizations

Property Group
Protective Sheath and Fitting

Property
Housing Type = high pressure

Property
Pad/Collar Type = 1x1 flat parallel

Property
Fitting conn nominal size = ½ in

Property
Mounting fitting type = compression

Enumeration
Housing Type

Enumeration
Pad/Collar Type

Enumeration
Fitting conn nominal size

Enumeration
Mounting fitting type

Extruder bolt
High pressure

½ in

Compression

ISA 20T2221 Picklist

<table>
<thead>
<tr>
<th>Line No</th>
<th>Field Prompt</th>
<th>Pick List Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>011</td>
<td>PROTECTIVE SHEATH AND FITTING</td>
<td>Extruder bolt</td>
</tr>
<tr>
<td>012</td>
<td>Housing type</td>
<td>High pressure</td>
</tr>
<tr>
<td>012</td>
<td>Housing type</td>
<td>Overbraded</td>
</tr>
<tr>
<td>012</td>
<td>Housing type</td>
<td>Pad design</td>
</tr>
<tr>
<td>012</td>
<td>Housing type</td>
<td>Tubular</td>
</tr>
<tr>
<td>012</td>
<td>Housing type</td>
<td>Tubular Reduced Tip</td>
</tr>
<tr>
<td>013</td>
<td>Pad/Collar type</td>
<td>1/4 in x 1 1/4 in</td>
</tr>
<tr>
<td>013</td>
<td>Pad/Collar type</td>
<td>1x1 flat parallel</td>
</tr>
<tr>
<td>013</td>
<td>Pad/Collar type</td>
<td>1x1 flat perpendicular</td>
</tr>
<tr>
<td>013</td>
<td>Pad/Collar type</td>
<td>1x1 formed parallel</td>
</tr>
<tr>
<td>013</td>
<td>Pad/Collar type</td>
<td>1x1 Pad W/Cover</td>
</tr>
<tr>
<td>013</td>
<td>Pad/Collar type</td>
<td>3/4x3/4 flat parallel</td>
</tr>
<tr>
<td>013</td>
<td>Pad/Collar type</td>
<td>3/8 in x 1 in</td>
</tr>
<tr>
<td>013</td>
<td>Pad/Collar type</td>
<td>NA</td>
</tr>
</tbody>
</table>
How to connect to the OIIE?
Each system/application participating in OIIE exchanges must have an adaptor.

Can be considered in two parts:

- CCOM (or data) adaptor: converts internal data format to MIMOSA CCOM
- ISBM adaptor: communication with ISBM
Building an OIIE Adaptor (Simplified)

1. Obtain Web-service definitions
   - SOAP/XML-based using WSDL
   - REST/JSON-based using OpenAPI

2. Determine in which OIIE Use Case(s), Scenario(s), and Event(s) the application will participate

3. Identify the CCOM data elements and BODs must be supported

4. Map internal data to CCOM data elements

5. Identify the ISBM services to be implemented

6. Implement required services, mappings, and other considerations (e.g., error logging, auditing, persistence, UIs, etc.)
OGI Pilot CBM Demo
OIIE OGI Pilot Phase 3.1 Activities 1-4 (end 2018 – mid-2019)

Debutanizer Tower Condenser Unit P&ID
- Worley Parsons: Hexagon (Proteus XML)

P&ID Logical Connection information
MIMOSA Structured Digital Asset Interoperability Registry

RFI/RFI Response (Greenfield)
- RFI – Functional requirements
- RFI Response – Models
- Request for Model properties (ISDDs)

Use Cases ISDD Based Way of Specifying, Selecting and Buying Devices and Equipment

Capital Project Asset Installation
- Asset instances selected from RFI Response (defined using ISDDs)
- Installed on P&ID Tag locations (defined using ISDDs)

Use Case Adding As-Built Information Using OIIE Events

Adding Detail to Prior Work
As-Designed O&M Takeoff using CCOM or Proteus

Procure w/ OAGIS
OIIE OGI Pilot Phase 3.1 Activities 5-8 (end 2018 – mid-2019)

Information Handover
- From Capital Project to Operations and Maintenance
- Over ISBM (Information Service Bus Model)

Condition Based Maintenance
- Diagnostics
- Prognostics
- Advisory Generation

Remove and Replace

RFI/RFI Response (Brownfield) Information Remediation
Questions?
OIIE Systems and Scenarios Landscape

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Machine condition assessment data processing & information flow blocks.

CBM According to ISO 13374

Sensor / Transducer / Manual Entry

External Systems, Data Archiving, & Block Configuration

- DATA ACQUISITION (DA)
- DATA MANIPULATION (DM)
- STATE DETECTION (SD)
- HEALTH ASSESSMENT (HA)
- PROGNOSTICS ASSESSMENT (PA)
- ADVISORY GENERATION (AG)

Technical Displays & Information Presentation
Condition Based Maintenance and IIoT

**Inter-Enterprise via ISBM**

- **Device Manufacturer Supplying Remote Diagnostic/Prognostic/Advisory Support**
- **Operational Risk Management System**
- **HSE and Operation Monitoring**
- **Prognostic & Health Management**
- **Supports remote queries for measurement data and publishes advisories via ISBM.**

**Intra-Enterprise ISBM**

- **Owner/Operator**
- **May be same physical instance as the intra-enterprise ISBM**

**Automated System Bus**

- **SDAIR**
- **Registry of digital asset data for contextualisation.**
- **ERP**
- **Support for different protocols as required by industry.**

**Maintenance Management System**

- **HSE and Operation Monitoring**
- **Prognostic & Health Management**

**IIoT Device**

- **May be same physical instance as the intra-enterprise ISBM**
- **Internally may have some or none of these systems.**
- **Support for different protocols as required by industry.**

**Device**

- **Automation and Control**
- **HSE and Operation Monitoring**
- **Sensor/Transducer**

**IIoT Device**

- **Registry of digital asset data for contextualisation.**

**SDAIR**

- **ERP**

**IIoT Device**

- **May be same physical instance as the intra-enterprise ISBM**
- **Supports remote queries for measurement data and publishes advisories via ISBM.**

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CCOM Contextualisation—Maintained by SDAIR

Each object uniquely identified by a UUID. Also refer back to the system of record.
Example—Mesh Networks

Model
Debutanizer
DZR 5000

And similar at the Asset level