NIST Open Industrial Digital Ecosystems Summit
and OAGi Symposium
Enabling Supplier Neutral Standards-based Interoperability

June 3rd - 6th 2019 at the
NIST NATIONAL CYBERSECURITY CENTER OF EXCELLENCE
Rockville, Maryland, U.S.A.

Co-sponsored by MIMOSA and OAGi
NIST Open Industrial Ecosystem Summit
OAGi and MIMOSA Cooperation Supporting the Open Industrial Interoperability Ecosystem (OIIE)

Summary
June 3, 2019
Alan T. Johnston
MIMOSA President
Process Industry Smart Manufacturing and Asset Life-cycle Management Using Standards Based Interoperability and the OIIE

Operations and Life-cycle Asset Management Processes

Supply Chain Integration

MOM Processes-Joint Collaboration
OpenO&M, IEC, ISO

Interoperability Ecosystem Management

ERP Process Models

System Models

Components Models

Industrial Process Models

Equipment Models
Device Models
Sensor Models

MIMOSA Focus

LOAGi Focus

Interoperability Ecosystem Management
Debutanizer Tower Condenser Unit P&ID
- Worley Parsons, Fluor
- Aveva, Hexagon (Proteus XML)
- Bentley (CCOM XML)

Adding Detail to Prior Work

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

As-Designed O&M Takeoff using CCOM or Proteus

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 OIIIE Events

Procure With OAGi
**Critical Infrastructure Risk Management**

NIST is working with MIMOSA on Interoperability for IIOT and Critical Infrastructure Risk Management Standardization.

**MIMOSA CCOM** can model the industrial processes, systems, components and risks as well as the sensor-based information. This includes ALL Risks which can be identified and modeled, including but not limited to cyber risks.

**NIST Summit – June 3-4**
Critical Infrastructure Sectors – From US PPD 21-2013

➢ Chemical
  • Commercial facilities
  • Communications
➢ Critical manufacturing
➢ Dams
➢ Defense industrial base
  • Emergency services
➢ Energy

➢ Financial services (including insurance)
  ➢ Food and agriculture
  • Government facilities
  • Healthcare and public health
➢ Information technology
➢ Nuclear reactors, materials, and waste
➢ Transportation systems
➢ Water and wastewater systems

The Sectors identified with arrowheads are asset intensive and share many engineering, IT and management practices as well as equipment and device classes where it is possible to standardize methods to Model, Monitor and Manage Processes, Systems and Components as well as ALL Associated Risks.
Cross Sector Smart Manufacturing and Critical Infrastructure Risk Management Using Standards Based Interoperability and the OIIE

Critical Infrastructure Risk Management Processes

MOM Processes-Joint Collaboration
OpenO&M, IEC, ISO

ERP Process Models
Risk Models

Supply Chain Integration

Equipment Models
Device Models
Sensor Models

Components Models
System Models
Industrial Process Models

Interoperability Ecosystem Management

L4
L3
L2
L1

MIMOSA Focus

OA Gi Focus

MOM Processes - Joint Collaboration
OpenO&M, IEC, ISO

ERP Process Models
Risk Models

Supply Chain Integration

Equipment Models
Device Models
Sensor Models

Components Models
System Models
Industrial Process Models

Interoperability Ecosystem Management

L4
L3
L2
L1

MIMOSA Focus

OA Gi Focus
Transforming the Oil and Gas Industry Using the OIIE
A Pragmatic Solution for Industrial Digitalization

Custom Integration

- Custom development
- Specific data adapters
- Owner/operator responsible for sustainment
- High Development and Sustainment Costs
- Inflexible and Fragile
- No practical basis for industry transformation

Open Industrial Digital Ecosystem

- Defined by supplier-neutral standards
- Lower switching costs, reduces supplier lock-in and large supplier control
- Enables innovation from SMEs
- Configuration rather than development
- Suppliers build and maintain standard adaptors with commercial support model
- Higher quality with lower costs and risks
- Adaptable and Evolutionary
- Practical Basis for industry transformation

Industry Standard Digital Ecosystem
- Supplier neutral – open source and COTS
- Standard shared set of standards
- Standard use case architecture
- Standard use cases, scenarios & events
- Standard APIs and services definitions
- Standard information payloads
- Standard adaptors
- Standard reference data - ISDDs
- Standard ecosystem administration
- Standard piloting testbed

Open Industrial Digital Ecosystem (OIIE)
ISO 18101

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OpenO&M Initiative – Formed 2004

Enterprise Business Systems
Enterprise Resource Planning (ERP)

OpenO&M™

Operations

Maintenance

Physical Asset Control
Real-time Systems

Level R4

Level R3

Level R2

Level R1

Level R0
ISA-95/IEC 62264 define an Operations Management Reference Architecture based on the Purdue Reference Architecture.

The OpenO&M Initiative, led by MIMOSA, extended the architecture to fully address life-cycle asset management in conjunction with Construction Industry Institute (CII). Collectively, this provides the basis for the Open Industrial Interoperability Ecosystem (OIIE) and ISO 18101 (ISO OGI TS).
Full Asset Life-cycle Management

Product Design
Product MFG

Process Engineer Simulate
Engineer Design
Procure
Construct

Device/Equip Manufacturing
Platform Integrator Capital Project

Operate & Maintain (O&M)

Completion, Commission and Startup

Continuous Improvement Feedback Loops

End of Life

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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**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

- **Events**
  - Individual Message Exchange
  - Specific Data Content
  - Required data processing
  - Expected Response Event
  - Implemented by CCOM BODS and possibly others

**User Stories**
- High-level
- Pictographic
- Depict 1 or more Use Cases, Scenarios, and/or Events
- Actors, Systems, Exchanges, Data
OIIE Standard Use Case List
Derived from OpenO&M Standard Use Case List – Circa 2007

OIIE Use Case 1 – Information Handover from EPC to O/O
OIIE Use Case 2 – Engineering Updates
OIIE Use Case 3 – Field Changes to Plant/Facility Engineering
OIIE Use Case 4 – Online Product Data Library Management

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 – Information Provisioning of O&M Systems
OIIE Use Case 11 – Enterprise Reference Data Library Management

OIIE Use Case 12 – RFI and RFI Response for Models Meeting Requirements (Greenfield & Brownfield)
OIIE Use Case 13 – Lockout-Tagout

OIIE Use Case 14 – Condition-Based Maintenance Data Acquisition
OIIE Use Case 15 – Capital Project Asset Installation

Current OIIE Use Cases Focus on Life-cycle Asset Management and OIIE Administration
May be expanded into more of Operations Management in conjunction with UWA/Kirkman
OIIIE Inter-Enterprise Systems Connectivity and Services Architecture Enabling Industry 4.0

EPC Firms
Engineering, Procurement and Construction

IT Networks

OEMs
Manufacturers
Enterprise Business Systems

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

Business Requirements

Manufactured Asset Data
(Make/Model Information, Serial #)

Operations & Maintenance Data
(Monitoring, Diagnostics, Prognostics)

Owner/Operators
Enterprise Business Systems

Automation and Control

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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

Connectivity Legend

- Smart, Cloud Friendly Enterprise Solutions Architecture For Digital Business Ecosystems

Automation and Control
HSE and Operation Monitoring
Prognostic & Health Management

Automation Control Bus

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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Some Relevant ISO Related Activities

**ISO TC 67**
Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries

**ISO TC 108**
Mechanical vibration and shock

**ISO TC 184**
Industrial automation systems and integration

**ISO TC 184 SC5**
Architecture, communications and integration frameworks

**ISO 14224**
Petroleum, petrochemical and natural gas industries -- Collection and exchange of reliability and maintenance data for equipment

**ISO 13374**
MIMOSA OSA-CBM

**ISO 13374 SC5**
Condition monitoring and diagnostics of machines

**ISO 13374 WG6**
Formats and methods for communicating, presenting and displaying relevant information and data

**ISO 15926**
Data for Process Industries

**ISO 15926-6**
10303-Product data representation and exchange

**ISO 18101: OGI TS**
Digitalization & Interoperability

**ISO 18435**
MIMOSA OSA-EAI

**ISO 18435 SC5**
Diagnostic and maintenance applications integration
ISO 13374 Standard

Machine Condition Assessment Data Processing & Information Flow Blocks

- Sensor / Transducer / Manual Entry
- Data Acquisition (DA)
- Data Manipulation (DM)
- State Detection (SD)
- Health Assessment (HA)
- Prognostic Assessment (PA)
- Advisory Generation (AG)

External Systems, Data Archiving, & Block Configuration

Technical Displays & Information Presentation

ISO 13374 Standard

Machine Condition Assessment Data Processing & Information Flow Blocks

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External Systems, Data Archiving, & Block Configuration

Technical Displays & Information Presentation

ISO 13374 Standard
Automation systems and integration — Oil and gas interoperability —

Part 1: Overview and fundamental principles

Systèmes d'automatisation et intégration — Interopérabilité entre les industries du pétrole et du gaz —
Partie 1: Vue d'ensemble et principes fondamentaux
“This document was prepared by Technical Committee ISO/TC 184, Automation systems and integration.

This document provides an overview and outlines the fundamental principles of the ISO 18101 series. Future parts of the ISO 18101 series will be developed including sets of industry developed use cases, once the use cases have been documented using the Open Industrial Interoperability Ecosystem (OIIIE) use case architecture and validated using the OIIIE Oil and Gas Interoperability (OGI) Pilot, with the results captured in Technical Reports. These use cases will incrementally define industry prioritized elements of the secondary business process, which is the scope of the ISO 18101 series.”
OIIE Oil and Gas Interoperability (OGI) Pilot
Sub-phase 3.1
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- Worley Parsons, Fluor
- Aveva, Hexagon (Proteus XML)
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Add In Detail to Prior Work

As-Designed O&M Takeoff using CCOM or Proteus

OIIIE Use Case 12; ISDD Based Way of Specifying, Selecting and Buying Devices and Equipment

OIIIE Use Case 15: Adding As-Built Information Using OIIIE Events

Procure With OAGi
OIIE OGI Pilot Phase 3.1 Activities 5-8 (Use Cases)

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

OIIE Use Case 1
Simulated

Condition Based Maintenance
Diagnostics
Prognostics
Advisory Generation

OIIE Use Case(s) 7, and 14

Remove and Replace

OIIE Use Case 5

RFI/RFI Response (Brownfield)
Information Remediation

OIIE Use Case 12