Technology Overview of MIMOSA's Open System Architecture for Enterprise Application Integration (OSA-EAI) Standard

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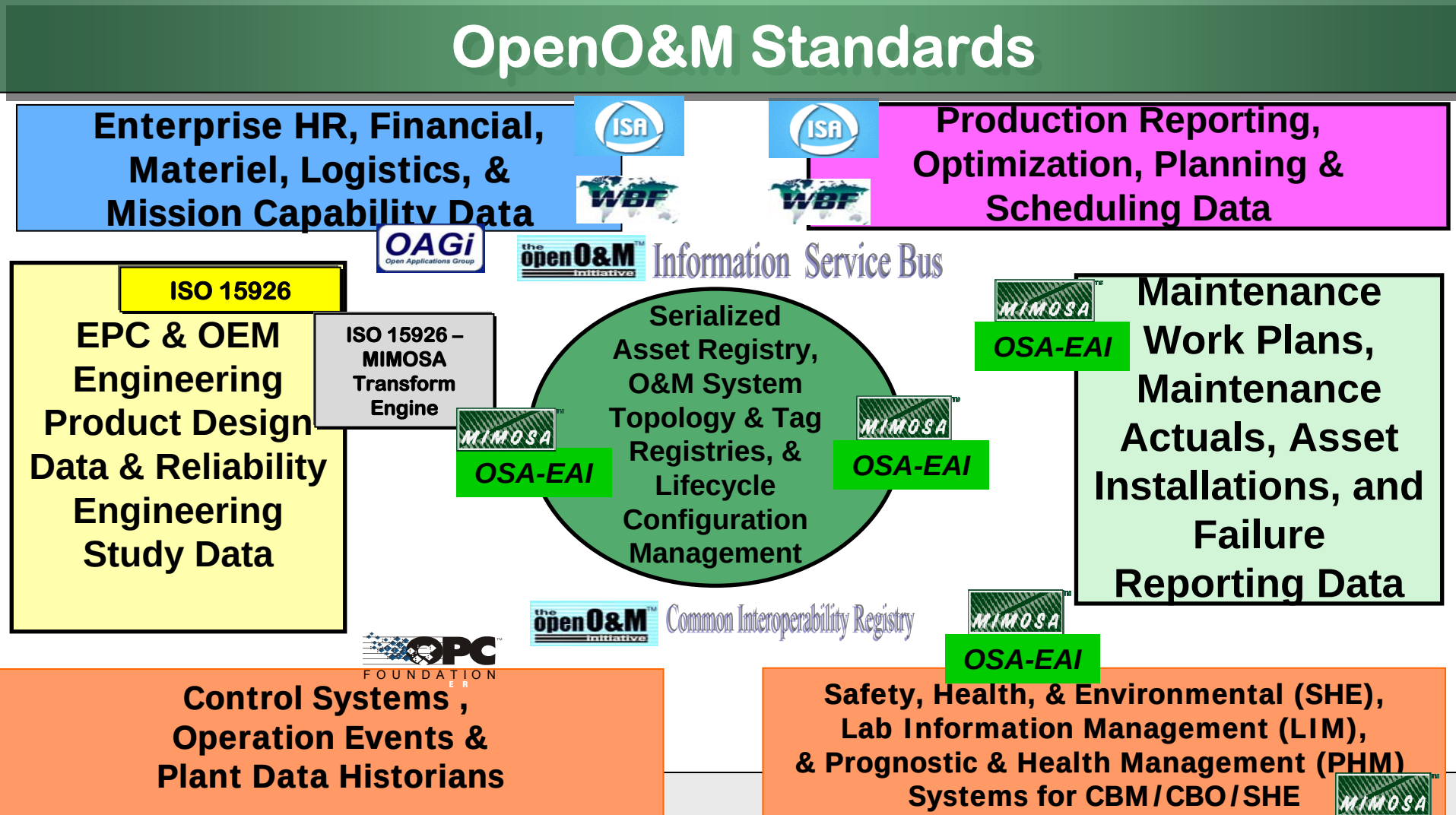
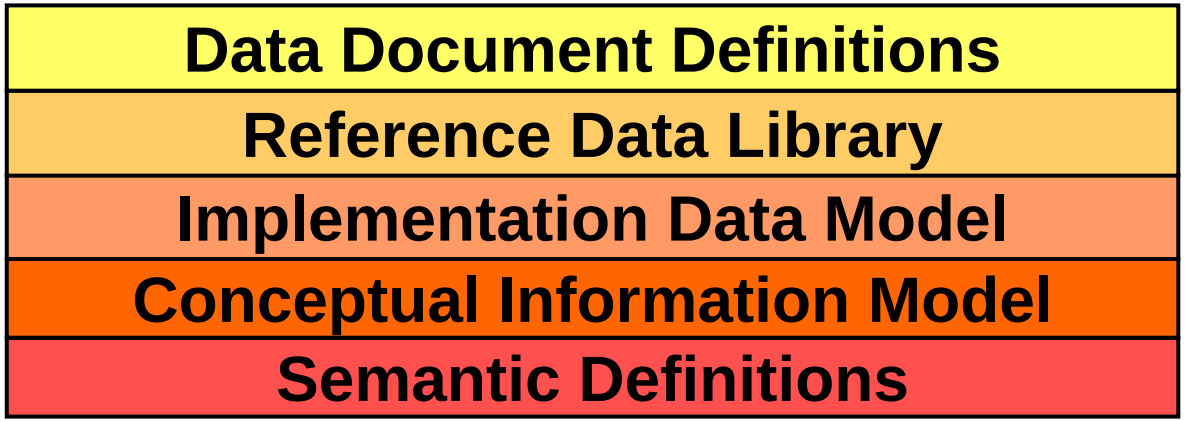
OpenO&M Standards



OSA-EAI Based Upon 5-Layer ISO 13374-2 Open Information Architecture Requirements

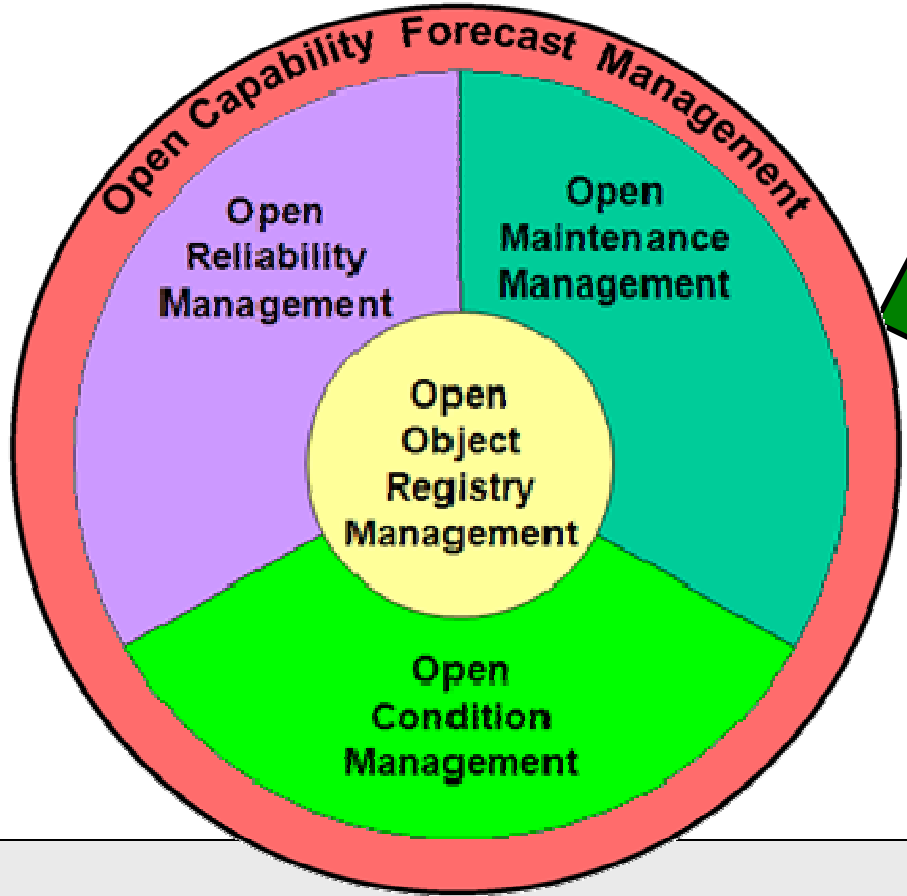


OSA-EAI Based Upon 5-Layer ISO 13374-2 Open Information Architecture Requirements

OSA-EAI V3.2.3 Information Architecture

CCOM-ML Document Producer / Consumer	CCOM-ML REST-ful HTTP Atomic Data API Client / Server	CCOM-ML ISBM Channel SOAP On-Ramp / Off-Ramp	Tech-Doc Document Producer / Consumer	Tech-CDE Document SOAP Client/Server	Tech-XML Atomic Data SOAP Client/Server
CCOM-ML Document XML Schema	CCOM-ML Atomic Data API Client / Server Transactions	CCOM-ML ISBM Channel On/Off-Ramp Transactions	CRIS-ML Document XML Schema	CRIS-ML Document Client/Server Transactions	CRIS-ML Atomic Data Client/Server Transactions
CCOM-ML Reference Data Library			CRIS-ML Reference Data Library		
CCOM Markup Language (CCOM-ML) Object Model			CRIS Markup Language (CRIS-ML) Persistence Model		
Common Conceptual Object Model (CCOM) UML Class Model					
Terminology Dictionary					

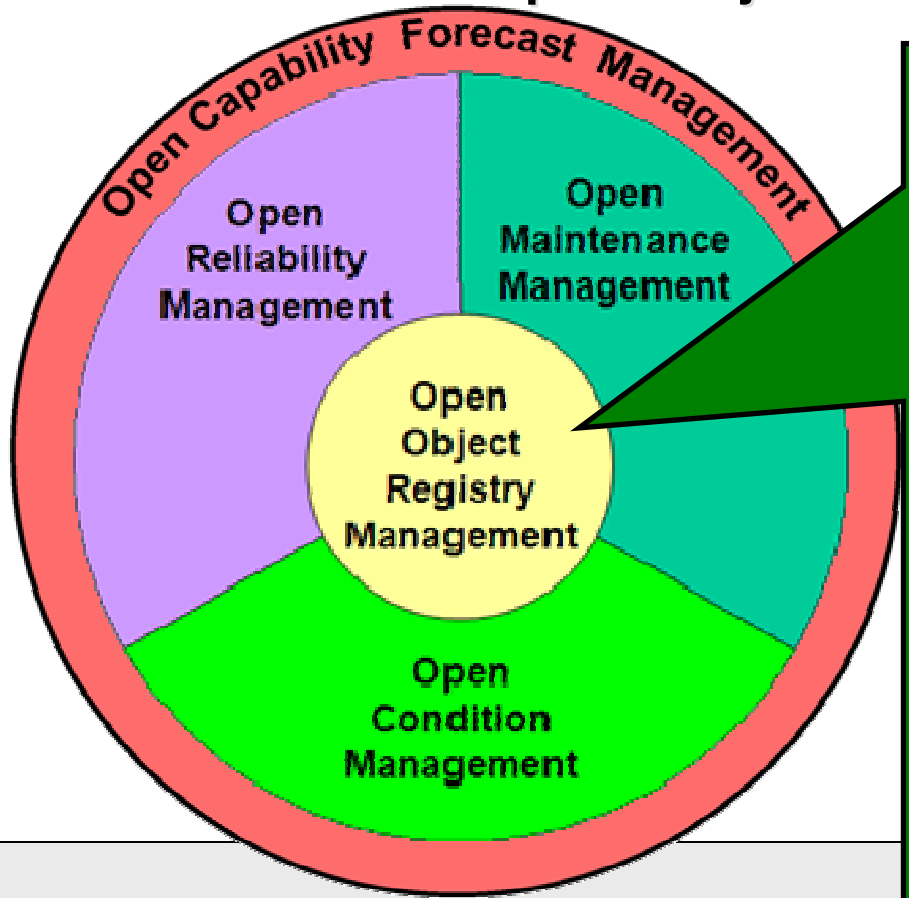
MIMOSA Open Systems Architecture for Enterprise Application Integration (OSA-EAI) Common Conceptual Object Model (CCOM)



OSA-EAI CCOM is a general-purpose UML Model with an XML Schema representation for the O&M Execution Environment, providing a neutral language for exchanging information between the following domains:

- **O&M system/process topology, with taxonomy & functional datasheets**
- **Product/Asset/Tag registry with datasheets and configuration management**
- **EAM / Maintenance Work Management**
- **Prognostic & Health Mgmt. (PHM) Assessment**
- **Periodic & On-line Machine Condition Monitoring**
- **Lab Information Management**
- **Safety, Health, & Environmental Monitoring**
- **Operational Risk Management**
- **Reliability Data**

MIMOSA Open Systems Architecture for Enterprise Application Integration (OSA-EAI) Common Conceptual Object Model (CCOM)



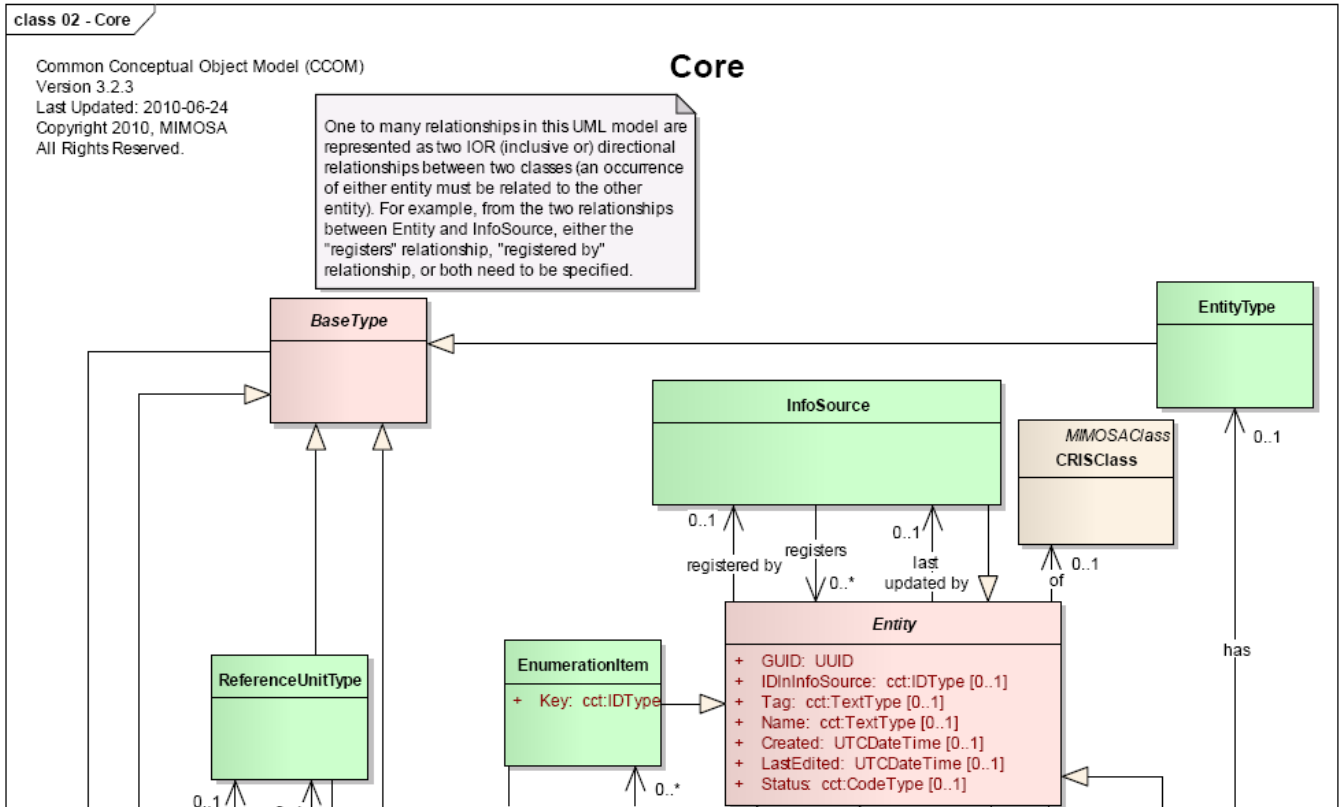
The MIMOSA Open Object Registry Is a Core O&M Interoperability Enabler for Asset-Intensive Industries.

- Provides for multiple full mesh networks for maintaining O&M system/process topologies and taxonomies with interrelationships between people, processes and systems in a Services Oriented Architecture.
- Designed to support the highly dynamic requirements of physical asset management such as configuration management.
- Provides cradle-grave tracking of serialized assets
- Provides O&M system/process topology & functional requirements

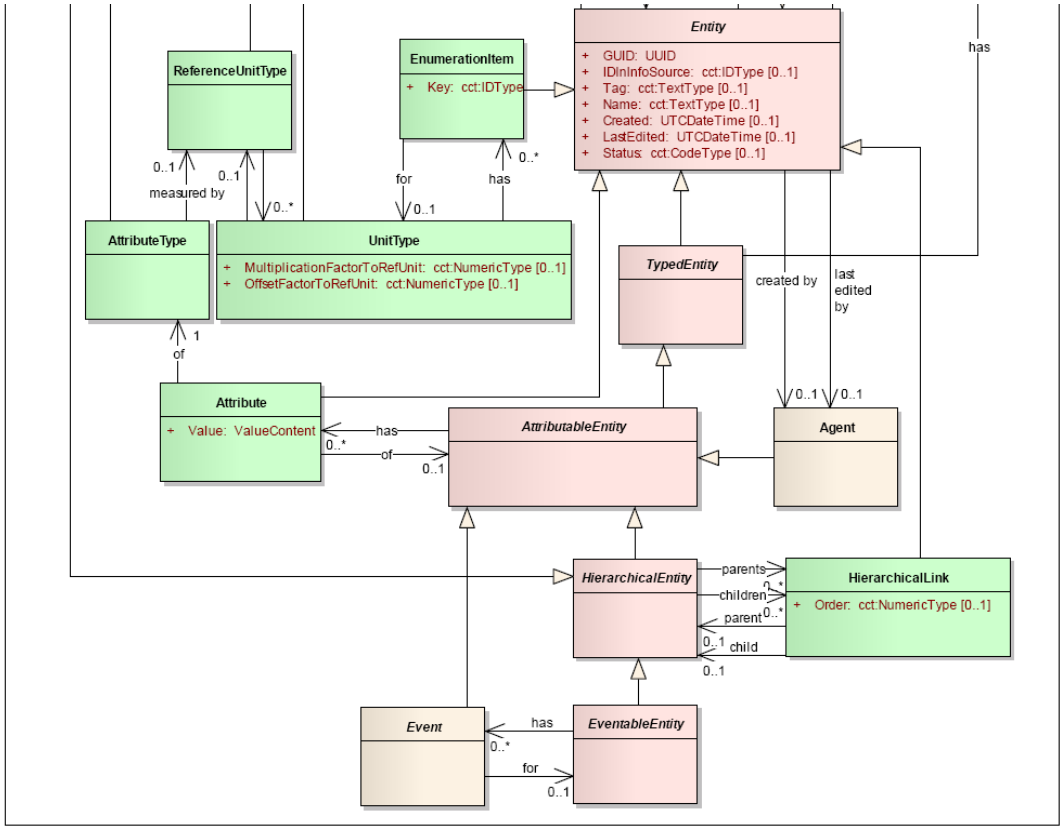
CCOM Open Object Registry Management

- **CCOM *Entity***
  - Abstract Class all Entities are Subclassed From
  - Contains a Mandatory, Immutable, Globally Unique Identifier for every CCOM entity in UUID format based on RFC 4122 16-byte (32-hex character) format
  - Contains a “Tag” (Short description) and “Name” attributes
  - Contains a “Created” and “LastEdited” attributes
  - Other Abstract SubClasses:
    - *TypedEntity (have 1 “Type” or class)*
      - *AttributableEntity (have unlimited attributes)*
        - *HierarchicalEntity (have parent-child relationships)*
          - *EventableEntity (have events)*
            - *Monitored Entity (have measurement locations)*

OSA-EAI Open Object Registry Management



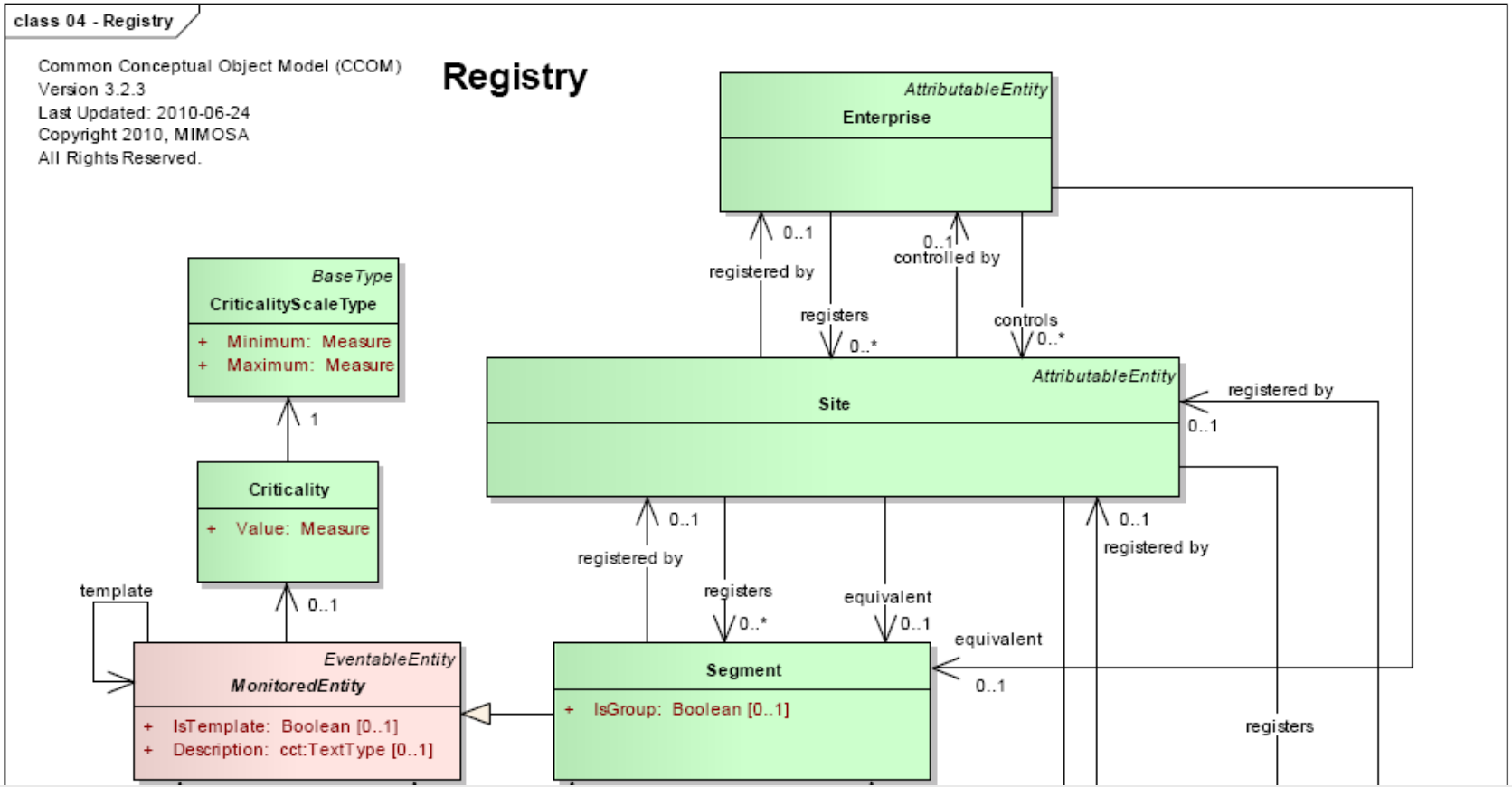
OSA-EAI Open Object Registry Management



CCOM Open Object Registry Management

- **CCOM *Segment***
  - Class of MonitoredEntity
  - Definition: Any Identified Structural Element

OSA-EAI Open Object Registry Management



CCOM Open Object Registry Management

- **CCOM *Segment***
  - Class of MonitoredEntity
  - Definition: Any Identified Structural Element
  - **Possible "Types" of CCOM Segments:**
    - **ISA-95 Equipment Class (Valve, Storage Tank, Process Separator, Tower, Heat Exchanger, Pump, Motor, Turbine, etc.)**

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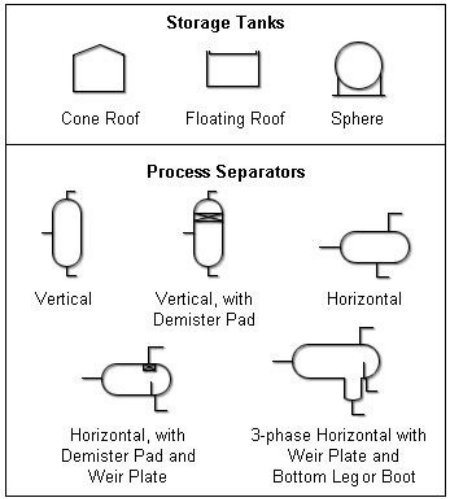

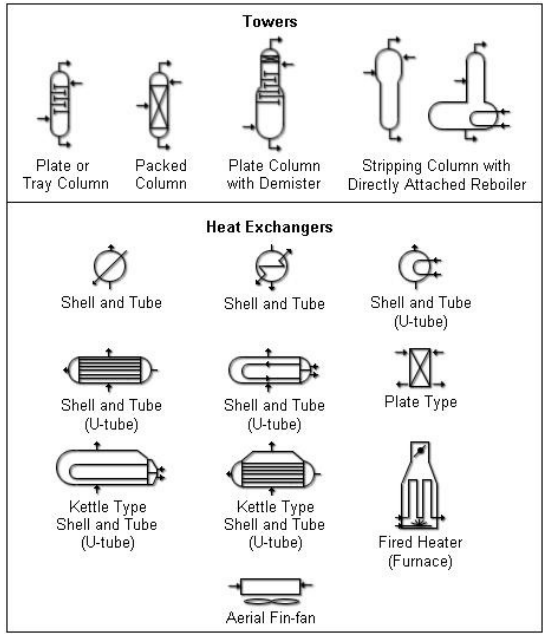

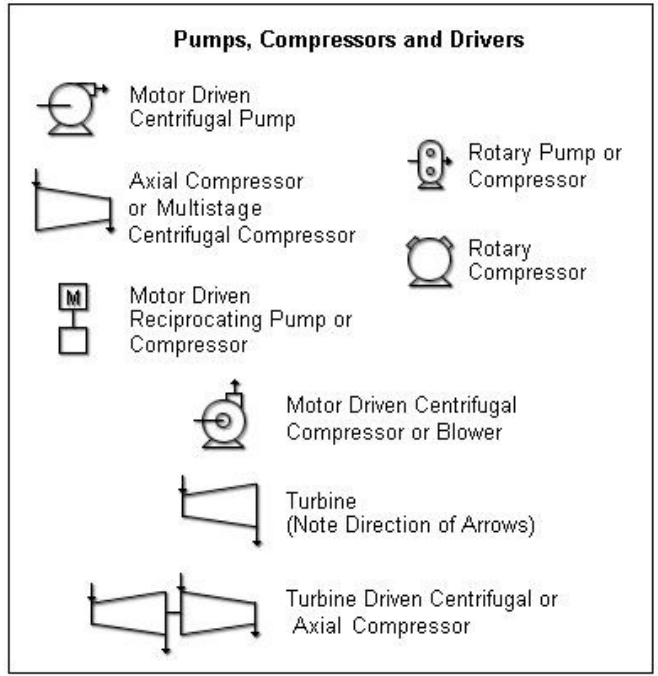

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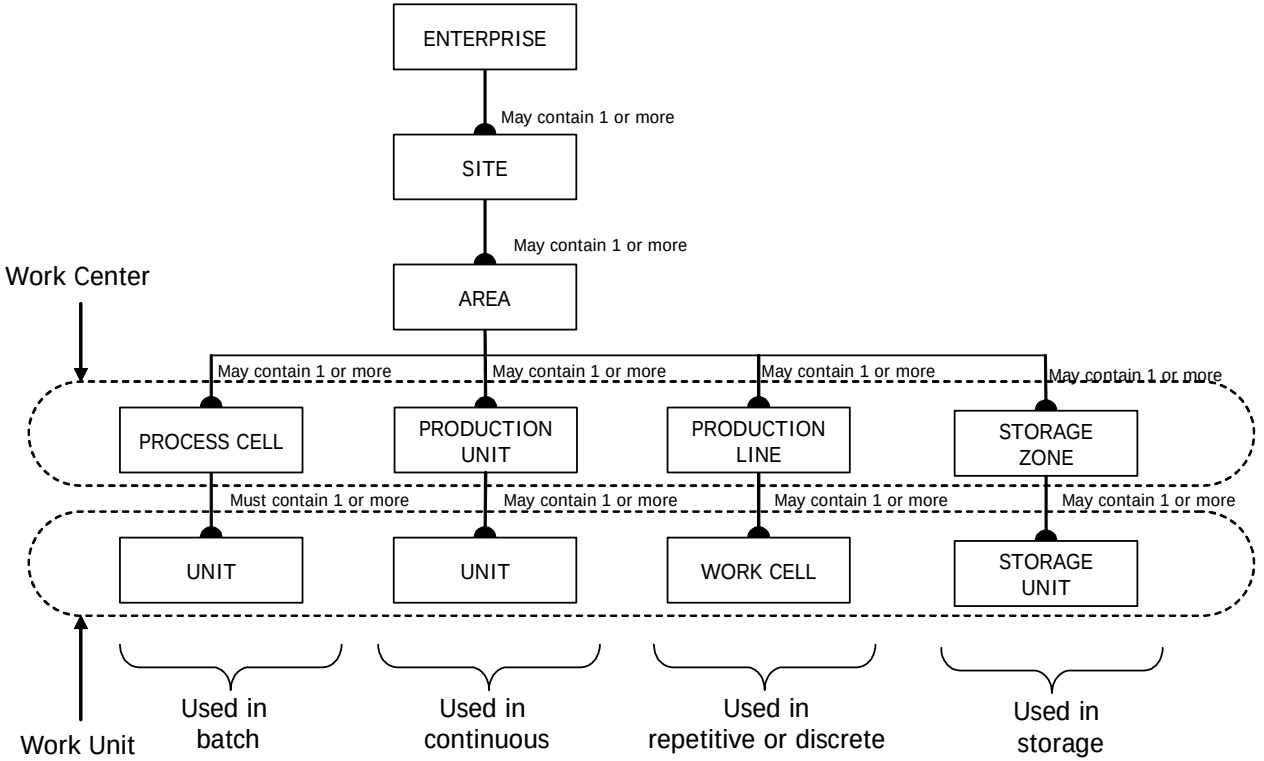
    - **ISA-95 Equipment Level (Enterprise Level, Site Level, Area Level, Process Cell Level, Work Unit Level, Unit Level, Production Unit Level, Production Line Level, Storage Zone Level, Storage Unit Level)**

OSA-EAI Open Object Registry Management



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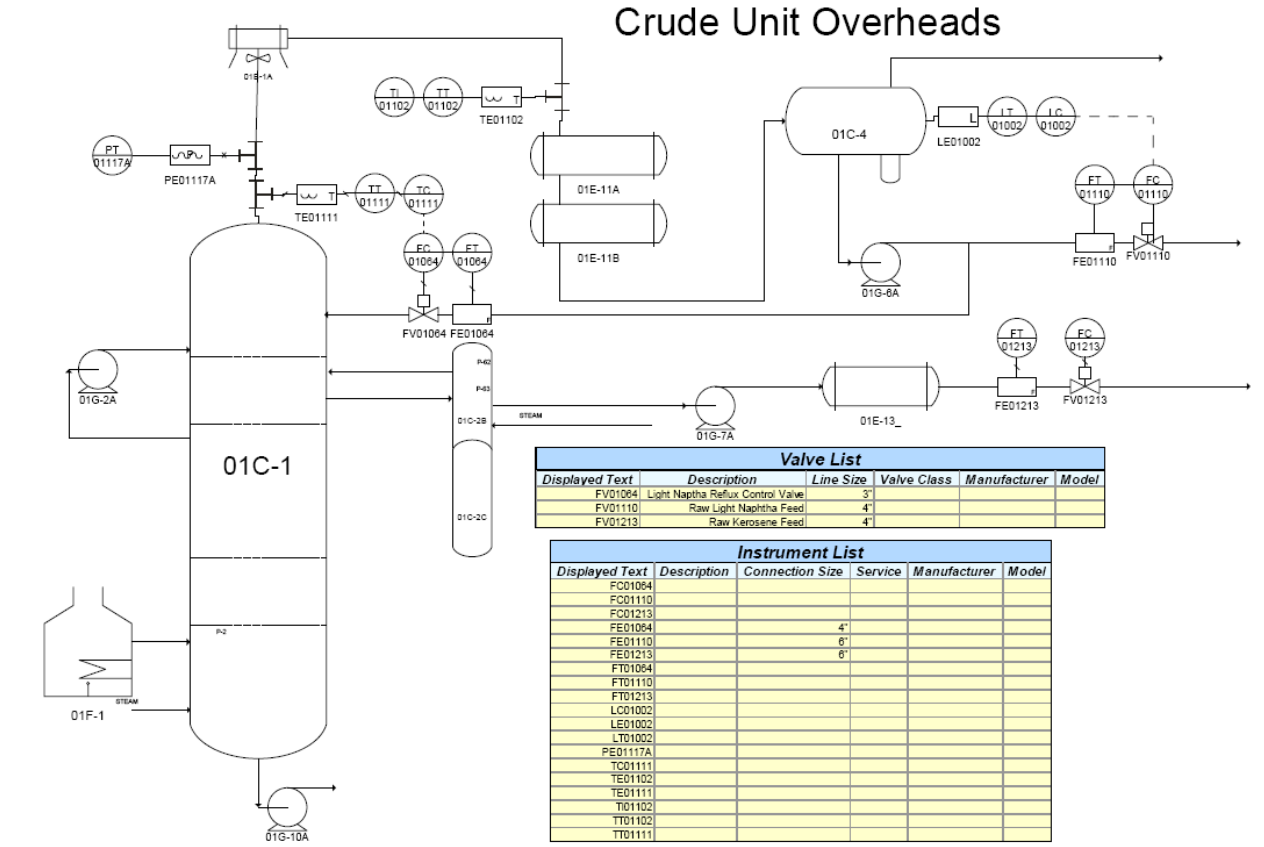
    - **P&ID Structural Element (Valve Tag, Instrument Tag, Piping Tag)**

OSA-EAI Open Object Registry Management



Valve List

Displayed Text	Description	Line Size	Valve Class	Manufacturer	Model
FV01064	Light Naptha Reflux Control Valve	3"			
FV01110	Raw Light Naphtha Feed	4"			
FV01213	Raw Kerosene Feed	4"			

Instrument List

Displayed Text	Description	Connection Size	Service	Manufacturer	Model
FC01064					
FC01110					
FC01213					
FE01064		4"			
FE01110		6"			
FE01213		6"			
FT01064					
FT01110					
FT01213					
LC01002					
LE01002					
LT01002					
PE01117A					
TC01111					
TE01102					
TE01111					
TI01102					
TT01102					
TT01111					

OSA-EAI Open Object Registry Management

Equipment and Valve Process Segment Tags

Equipment Tags	Description
C-200	Wet Gas Compressor
D-200	Main Fractionator Overhead Receiver
D-201	Wet Gas Compressor Knockout Drum
E -209	Main Fractionator Overhead Condenser
E-210A	Main Fractionator Overhead Trim Condenser
E-210B	Main Fractionator Overhead Trim Condenser
M-200	Wet Gas Compressor Motor
P-209	Main Fractionator Reflux Pump
P-210	Main Fractionator Reflux Spare Pump
P-211	Naphtha Product Pump
P-212	Naphtha Product Spare Pump
T-200	Main Fractionator
Valve Tags	**Description**
FV215	T-200 Reflux Flow Control Valve
FV218	C-200 Spillback Surge Flow Control Valve
FOV236	D201 Knockout Drum Level Valve
FOV240	E210A,B exchanger Cooling Water Valve
LV203	D-200 Level Control Valve
LV204	D-200 Boot Level Control Valve
PV204	Flare D-200 Wet Gas Pressure Control Valve
PV205	D-200 Wet Gas Pressure Control Valve

OSA-EAI Open Object Registry Management

Instrumentation Process Segment Tags

TAG ID	Description	SI Units		English Units	
		Range	Unit	Range	Unit
FC215	T – 200 Overhead Reflux	0 – 50.0	M3 /hr	0 – 7500.0	Bpd
FT215	T – 200 Reflux Transmitter				
FC216	Naphtha Product	0 – 80.0	M3/hr	0 – 12000.0	Bpd
FT216	Naphtha Product transmitter				
FC218	C – 200 Spillback Surge Control	0 – 24000.0	Std-M3/hr	0 – 20000.0	MStdFt3/Day
FT218	C–200 Spillback Surge Transmitter				
FI217	D – 200 Wet Gas to C – 200	0 – 30000.0	Std-M3/hr	0 – 25000.0	MStdFt3/Day
FT217	Wet Gas to C – 200 Transmitter				
FI219	C – 200 Spillback Std – M3/hr	0 – 16000.0	Std-M3/hr	0 – 13000.0	MStdFt3/Day
FT219	C - 200 Spill back Transmitter				
LT205	D-201 Level Transmitter	0 – 100.0	%	0 – 100.0	%
LA205A	D-201 Wet Gas Knock Out Drum	NORMAL ALARM		NORMAL ALARM	
LA205B	D-201 Wet Gas Knock Out Drum	NORMAL ALARM		NORMAL ALARM	
LT203	D-200 OVHD Receiver Transmitter	0-100.0	%	0-100.0	%

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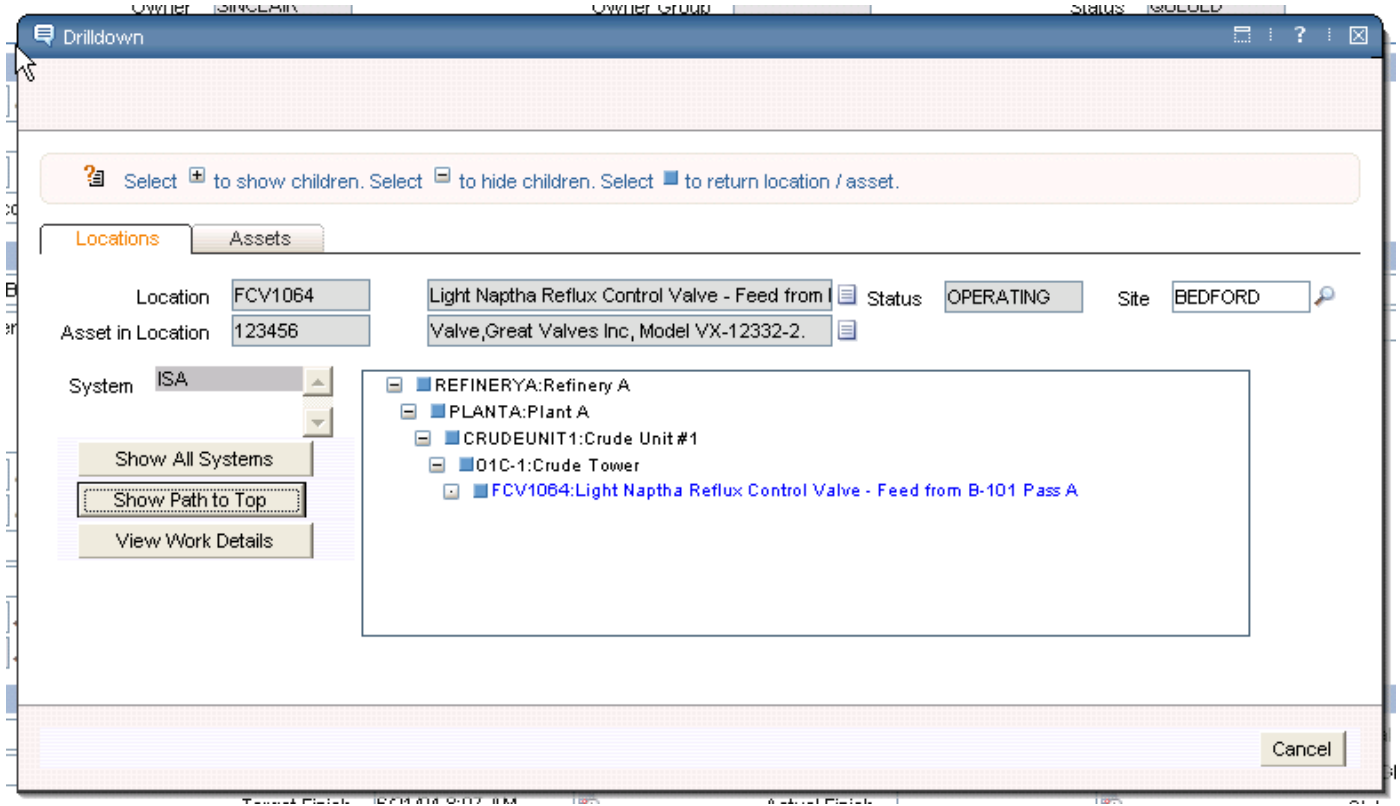
    - ISA-95 Equipment Level (Enterprise Level, Site Level, Area Level, Process Cell Level, Work Unit Level, Unit Level, Production Unit Level, Production Line Level, Storage Zone Level, Storage Unit Level)
    - P&ID Structural Element (Valve Tag, Instrument Tag, Piping Tag)
    - **Maintenance Work Unit**

OSA-EAI Open Object Registry Management



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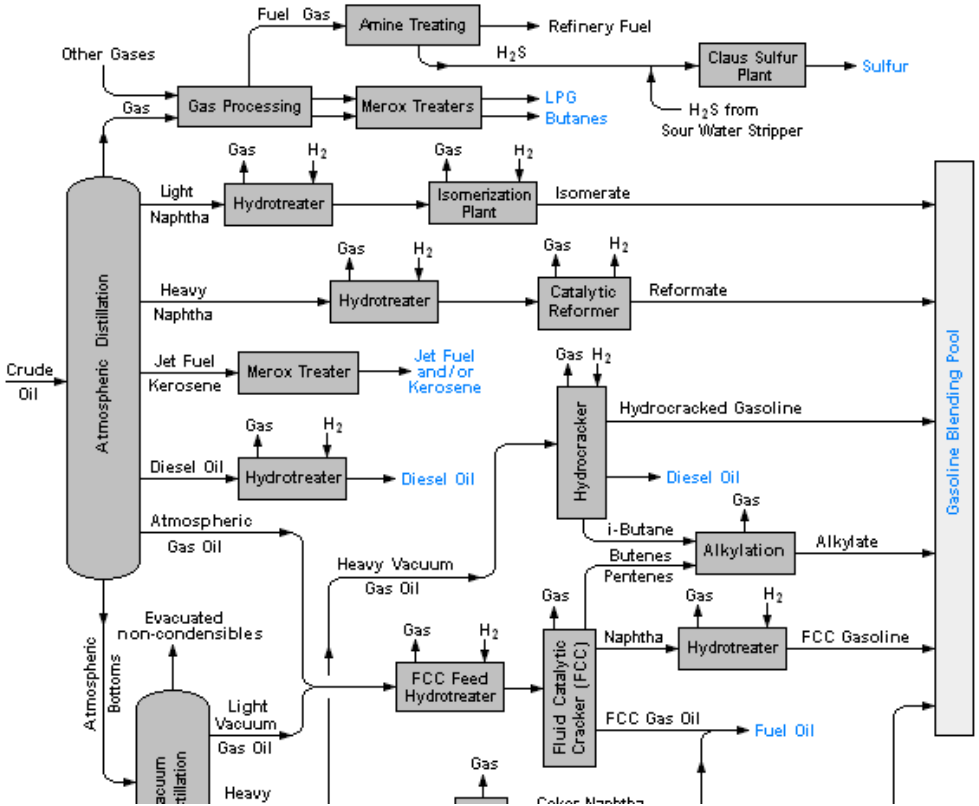
    - P&ID Structural Element (Valve Tag, Instrument Tag, Piping Tag)
    - Maintenance Work Breakdown “Functional Location”
    - **Process Flow Diagram Node**

OSA-EAI Open Object Registry Management



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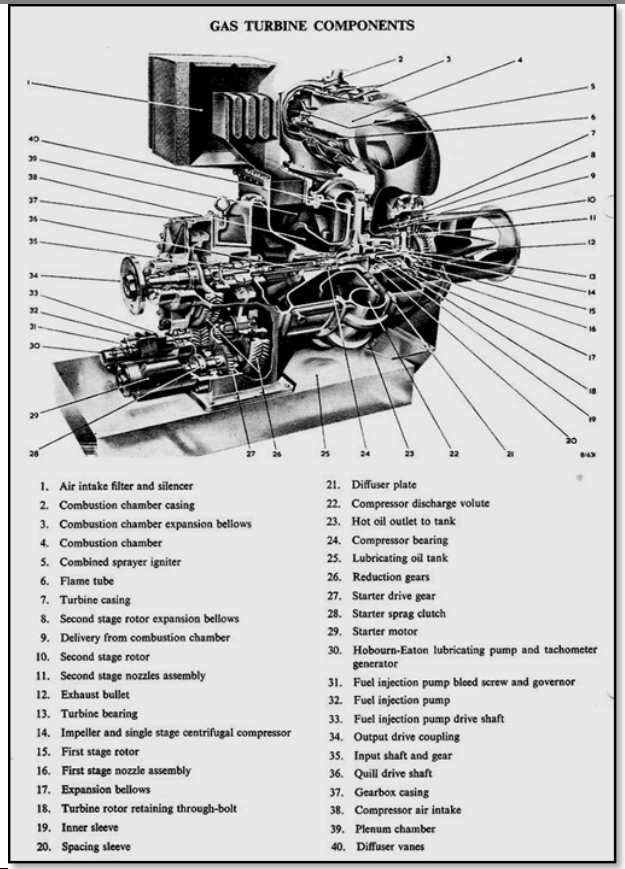
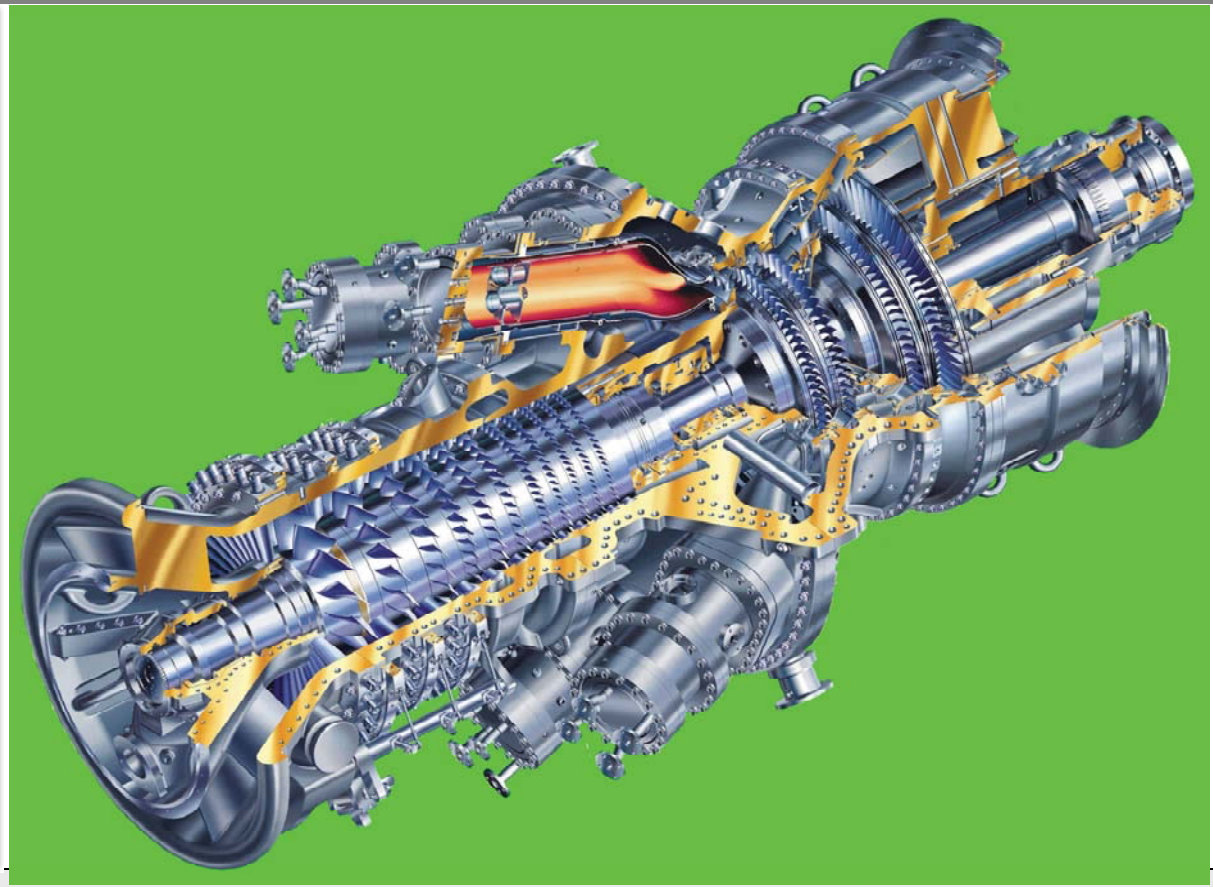
    - P&ID Structural Element (Valve Tag, Instrument Tag, Piping Tag)
    - Maintenance Work Breakdown “Functional Location”
    - Process Flow Diagram Node
    - **Model Part Breakdown “Component”**

OSA-EAI Open Object Registry Management





CCOM Open Object Registry Management

- **CCOM *Network***
  - Class of HierarchicalEntity
  - Definition: A Directed, Ordered MultiGraph of CCOM Segments used to Represent a Structured Configuration at a Particular Point in Time
  - Edge-Labeled Multidigraph (Directed Multigraph) permitted to have Loops with Ordered Edges

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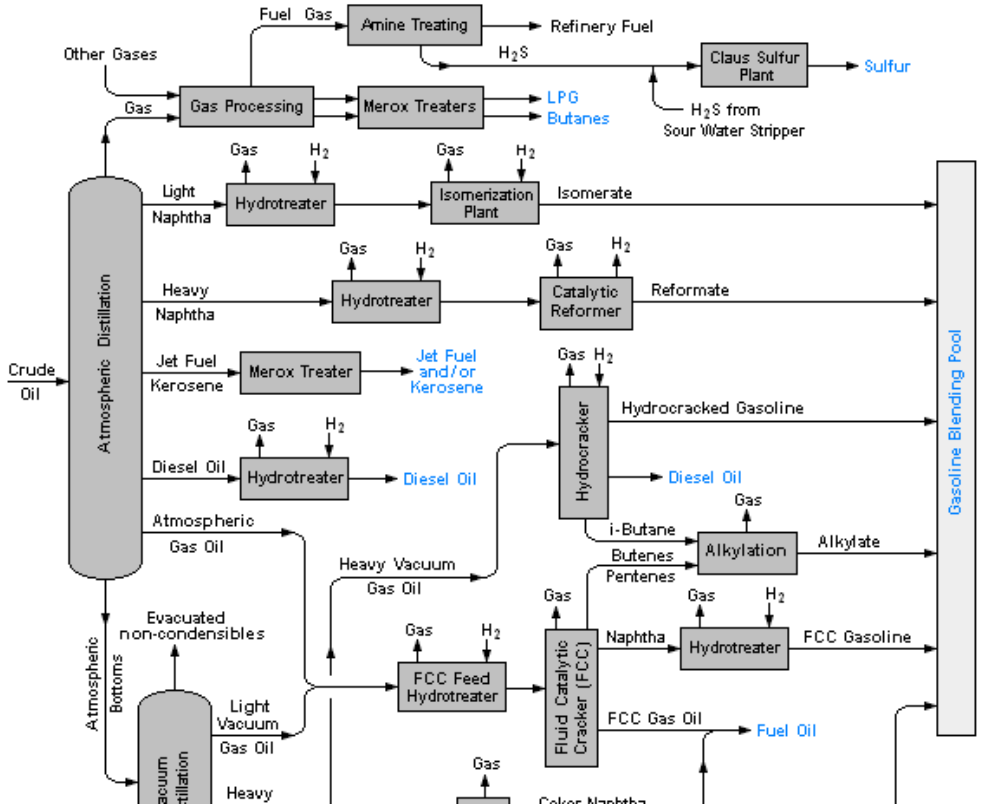
  - Edge-Labeled Multidigraph (Directed Multigraph) permitted to have Loops with Ordered Edges
  - **Default CCOM Network Type:**
    - **ISA-95 Equipment Level Breakdown Structure (Enterprise Level, Site Level, Area Level, Process Cell Level, Work Unit Level, Unit Level, Production Unit Level, Production Line Level, Storage Zone Level, Storage Unit Level)**
  - **Other CCOM Network "Types" which "Reuse" same Segments**
    - **P&ID Network Structure(Valve Tag, Instrument Tag, Piping Tag)**
    - **Maintenance Work Breakdown Structure**
    - **Taxonomy Parent-Child Structure**
    - **Maintenance Work Breakdown Structure**
    - **Process Segment Routing**

CCOM Open Object Registry Management

- **CCOM *NetworkConnection***
  - Class of TypedEntity
  - Definition: An Ordered “Edge” of a Directed, Ordered MultiGraph between 2 CCOM Segments
  - CCOM NetworkConnection Types:
    - Parent-Child
    - Primary Input-Output
    - Secondary Input-Output

OSA-EAI Open Object Registry Management



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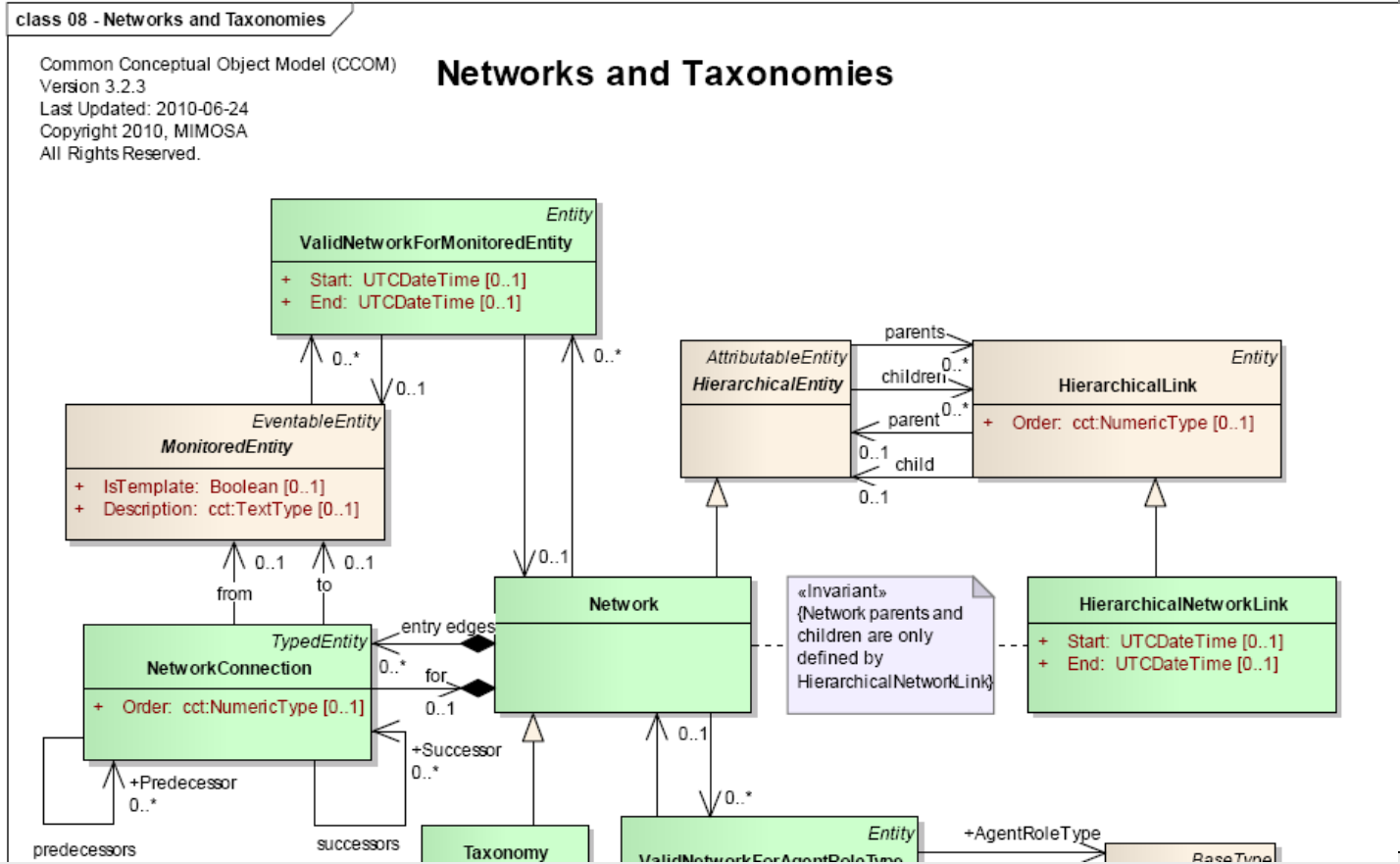

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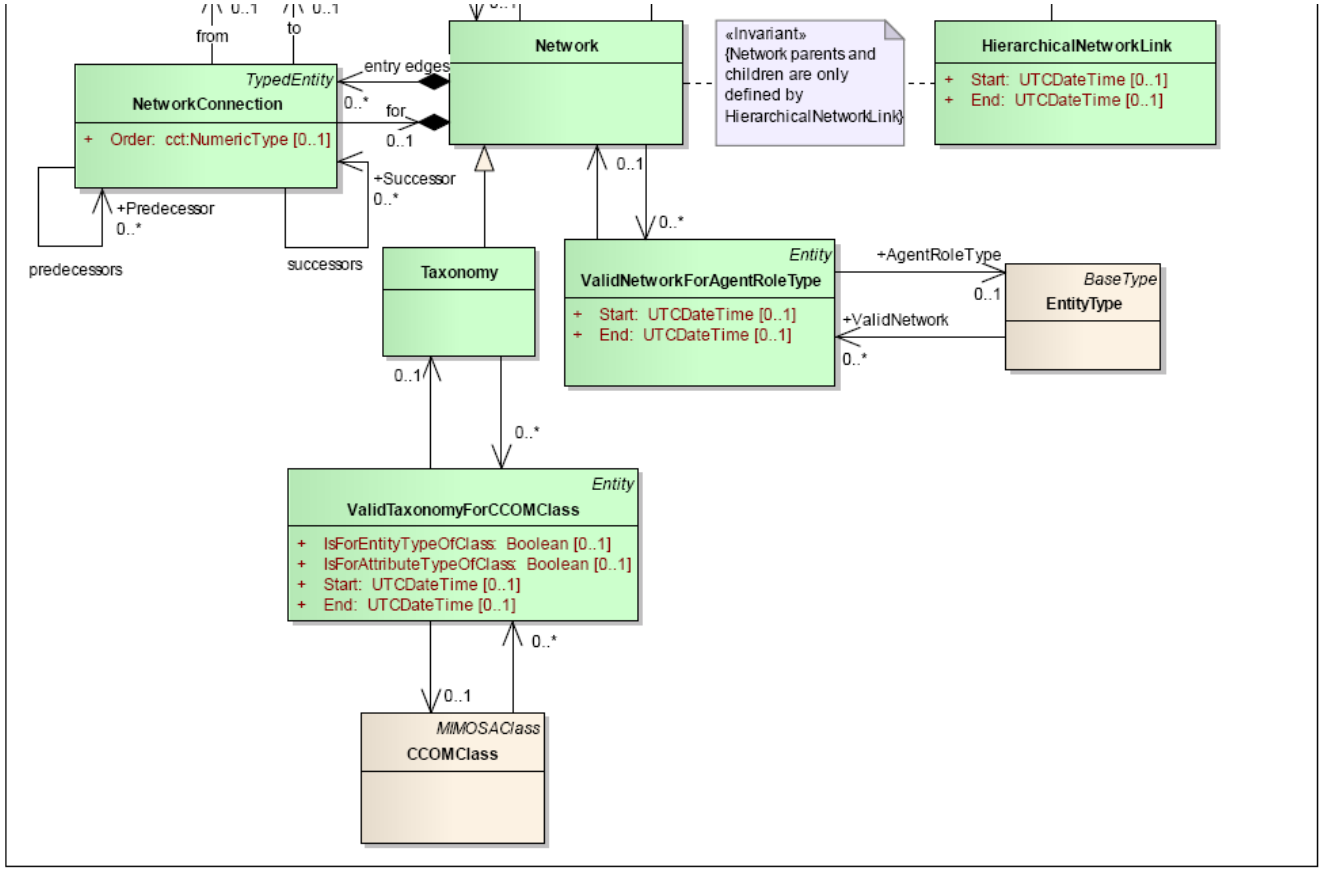


CCOM Open Object Registry Management

- **CCOM *Model***
  - Class of MonitoredEntity
  - Definition: As-Designed OEM Product
  - Optionally has an associated Manufacturer
  - Possible “Types” of CCOM Models:
    - ISA-95 Equipment Class (Valve, Storage Tank, Process Separator, Tower, Heat Exchanger, Pump, Motor, Turbine, etc.)
    - ISO 15926 Ontology Classes

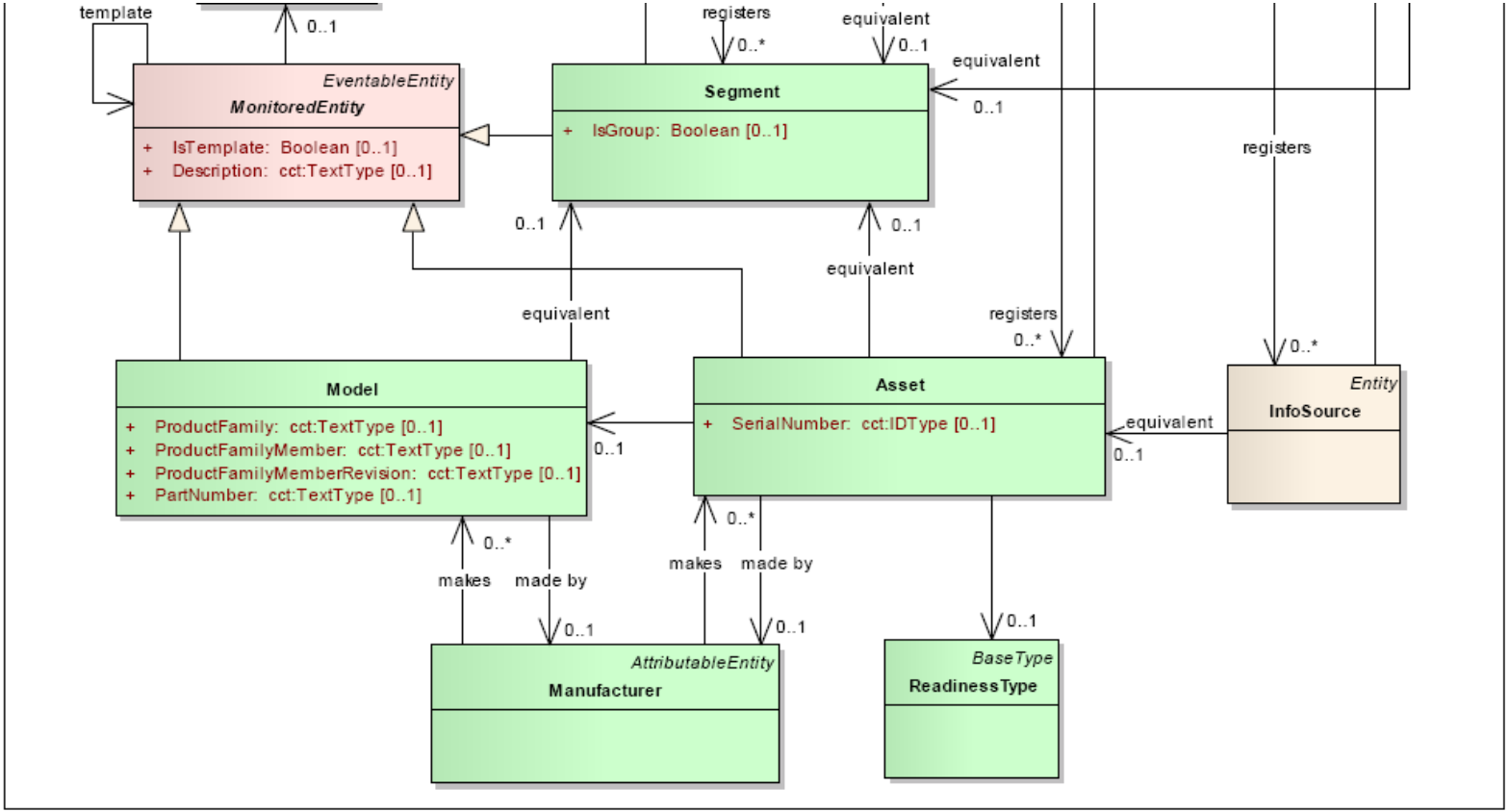
CCOM Open Object Registry Management

- **CCOM *Asset***
  - Class of MonitoredEntity
  - Definition: Any Tangible Serialized Object
  - Possible “Types” of CCOM Assets:
    - ISA-95 Equipment Class (Valve, Storage Tank, Process Separator, Tower, Heat Exchanger, Pump, Motor, Turbine, etc.)
    - ISO 15926 Ontology Classes

CCOM Open Object Registry Management

- **Asset Lifecycle Tracking**
  - Class of MonitoredEntity
  - Definition: Any Tangible Serialized Object
  - Possible “Types” of CCOM Assets:
    - ISA-95 Equipment Class (Valve, Storage Tank, Process Separator, Tower, Heat Exchanger, Pump, Motor, Turbine, etc.)
    - ISO 15926 Ontology Classes
  - **Birth-Death Asset Lifecycle Tracking**
    - **Which CCOM Segment has this Asset Been Installed In Over Its Life**
    - **What “Product Models” has this Asset Been Over Its Life**

OSA-EAI Open Object Registry Management



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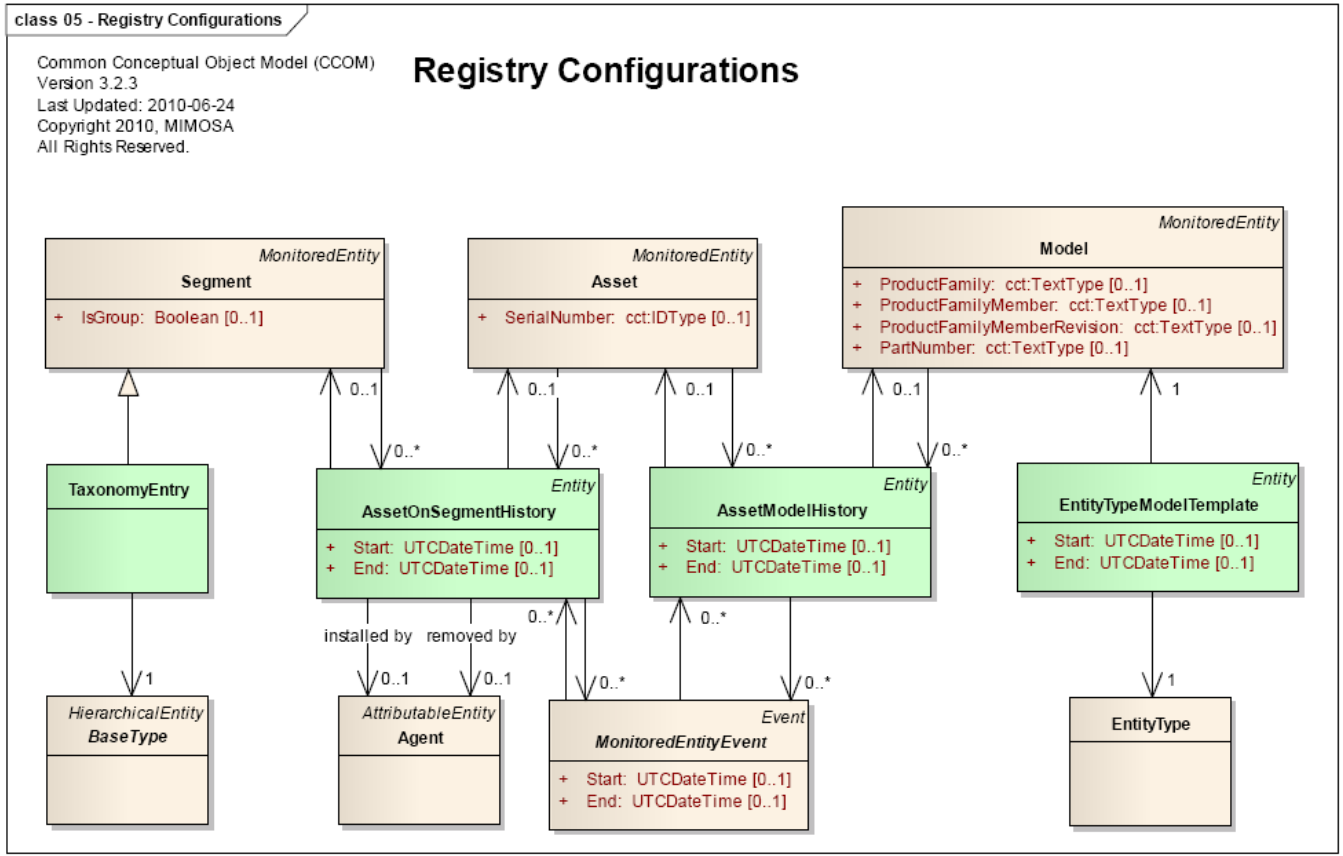
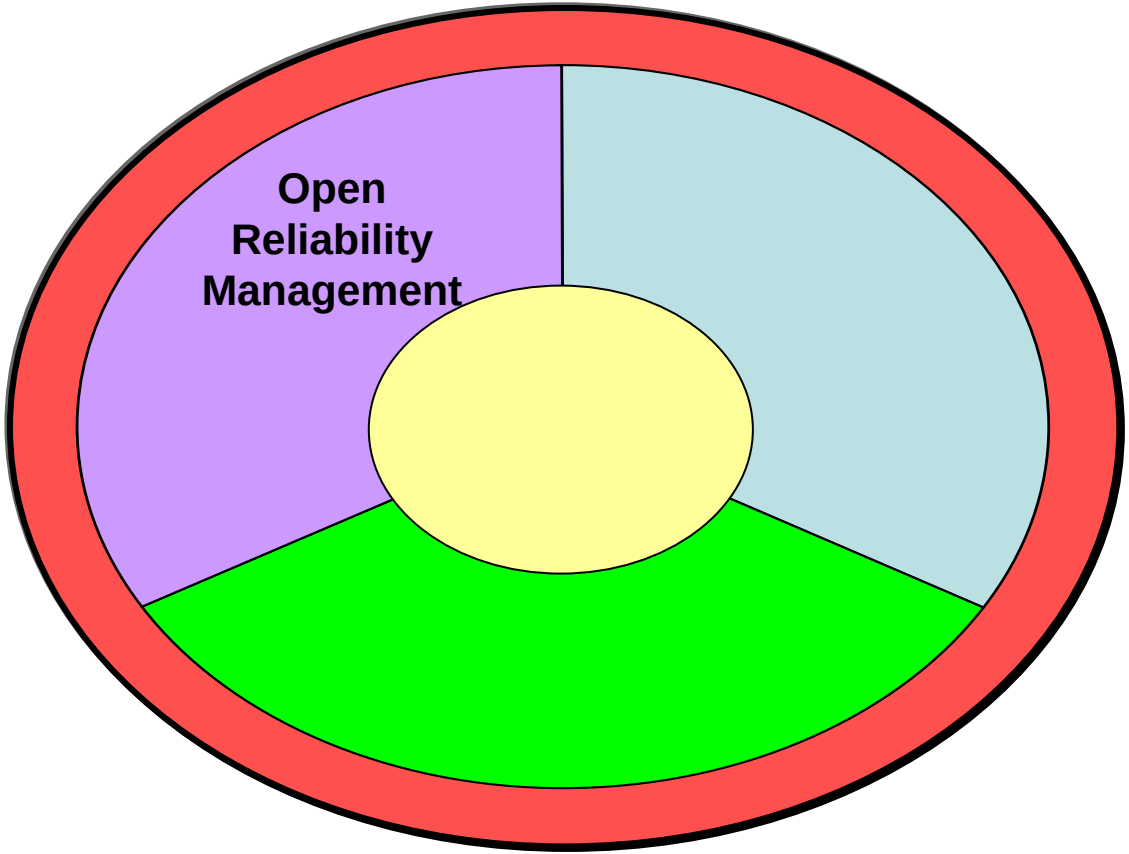


OSA-EAI Open Reliability Management



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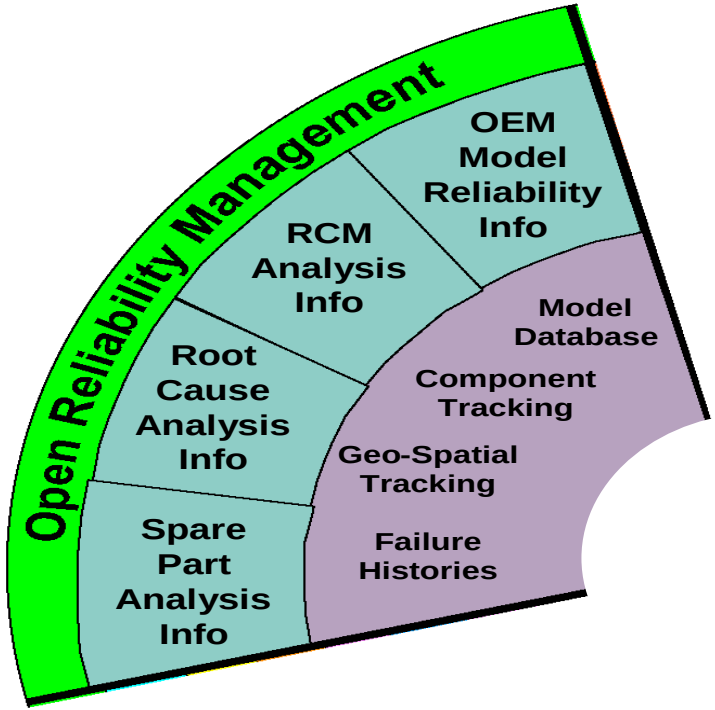
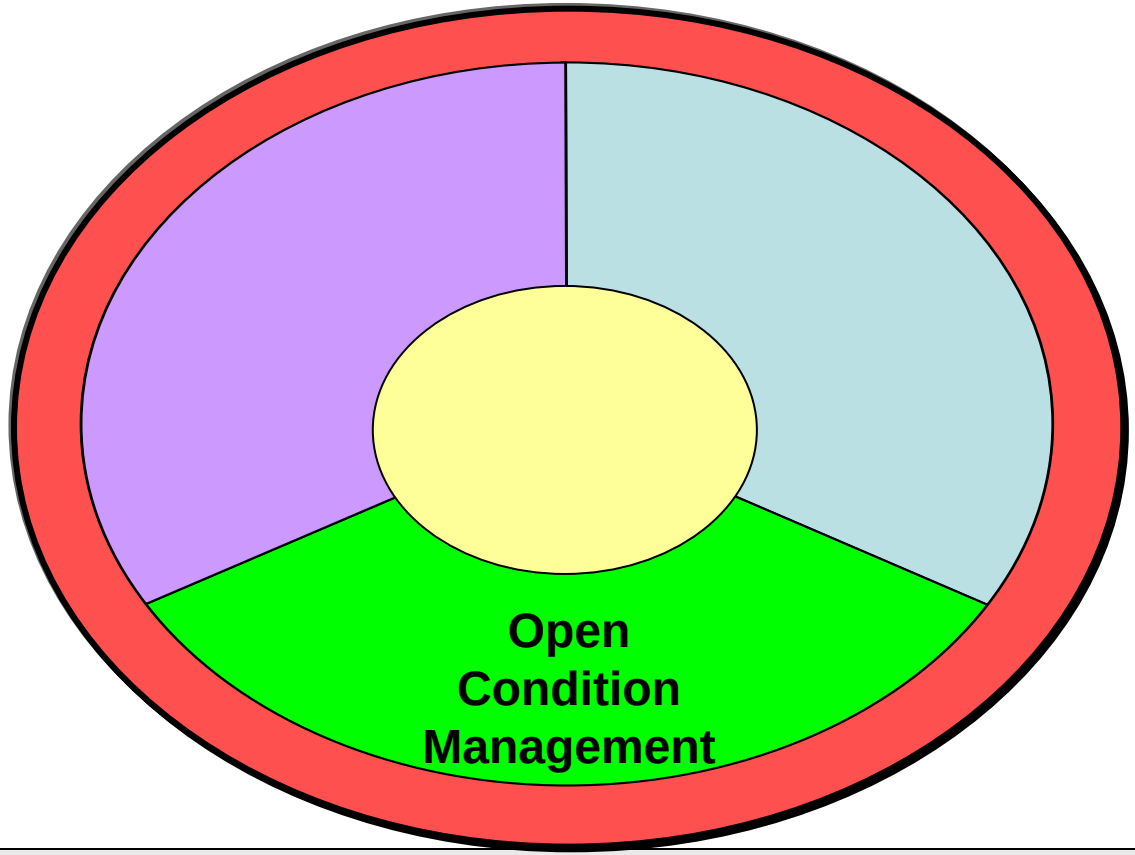


OSA-EAI Open Reliability Management

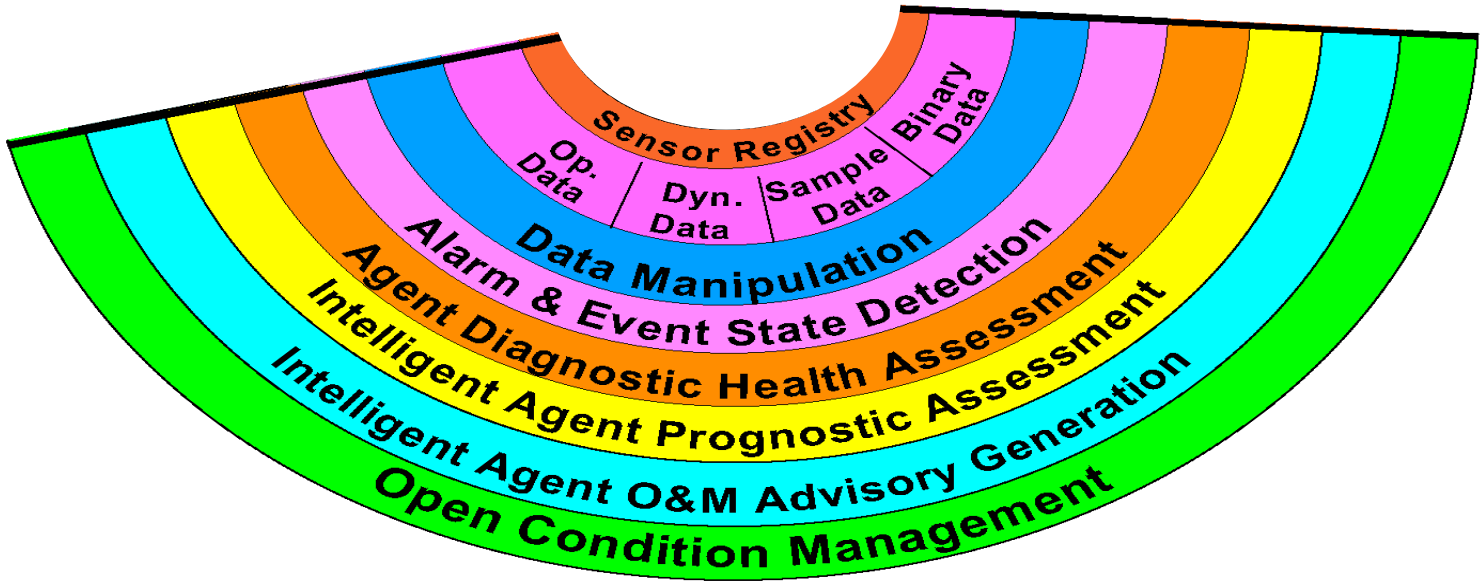
- Provide a consistent information architecture for managing all physical asset reliability information in an open, distributed, multi-vendor, multi-system environment.
- Based on MIMOSA's physical asset registry
- Enables continuous improvement throughout system, sub-assembly and component life-cycles
- Supports enterprise-wide, continuous RCM and FMECA analysis
- Enables enterprise-wide component tracking, including geo-spatial tracking
- Supports OEM model-specific problem reporting
- Provides information to support spare part optimization
- Incorporates root cause analysis information

OSA-EAI Open Condition Management



OSA-EAI Open Condition Management

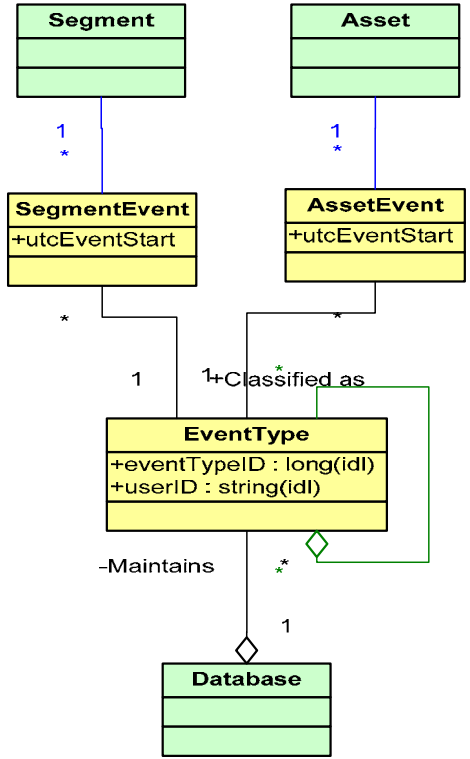
Safety, Health, & Environmental (SHE),
Lab Information Management (LIM),
& Prognostic & Health Management (PHM)
Systems for CBM/CBO/SHE



OSA-EAI Open Condition Management

- Provides a consistent information architecture for managing all physical asset condition management information in an open, distributed, multi-vendor, multi-system environment.
- Based on MIMOSA's physical asset registry
- Conforms to ISO 13374 standard for Machine Condition Monitoring & Diagnostics
- Manages sensor registry using a general measurement location with a measurement location type
- Manages meta-data, raw data, and computational data from a wide variety of technologies
  - Operational data monitoring
  - Vibration/sound dynamic data monitoring
  - Oil/fluid/air sample analysis
  - Thermographic image analysis
  - Binary large object (BLOB) data monitoring
- Supports intelligent agent diagnostic analysis, prognostic analysis, remaining useful life estimates, future failure mode probabilities

OSA-EAI Open Condition Management



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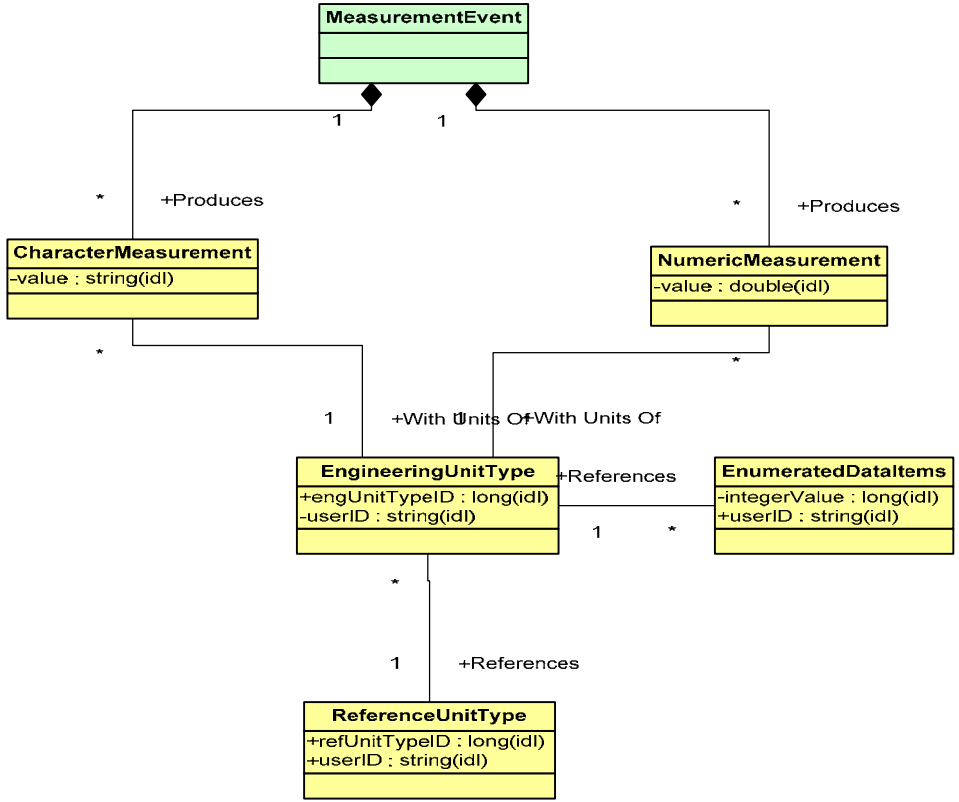
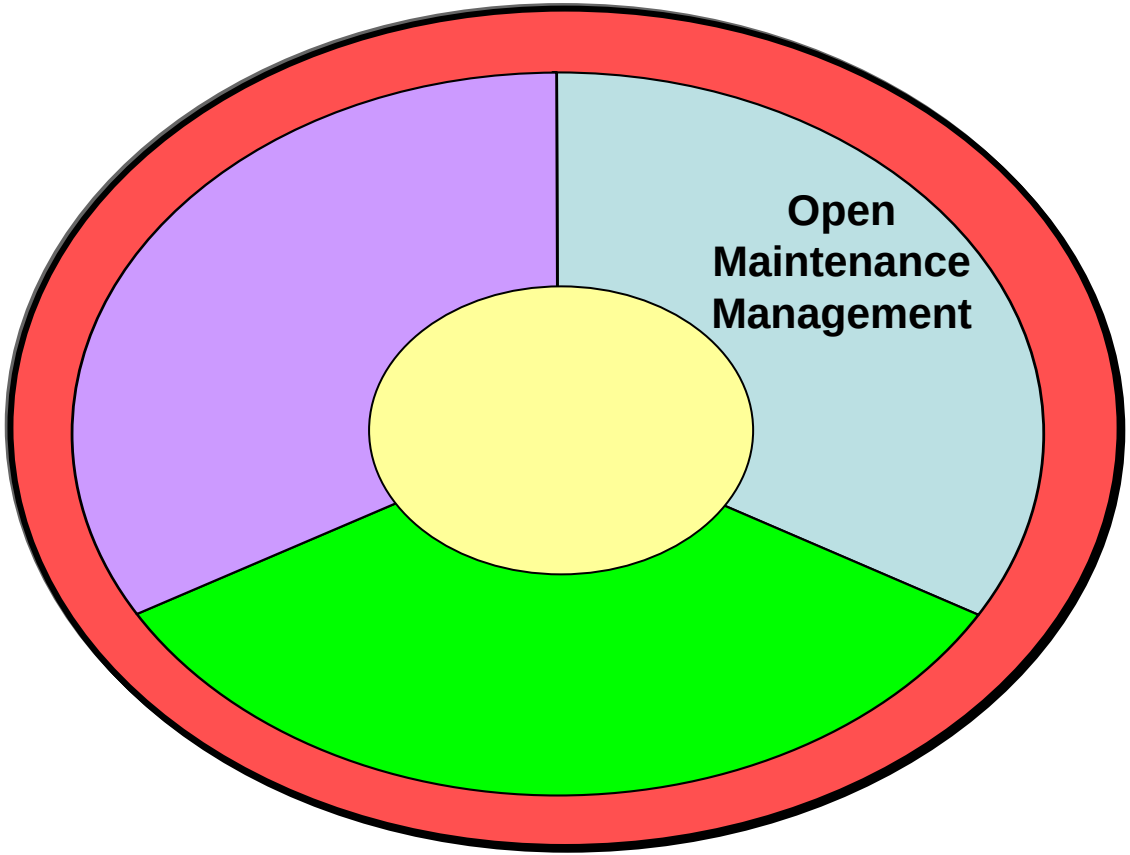


OSA-EAI Open Maintenance Management



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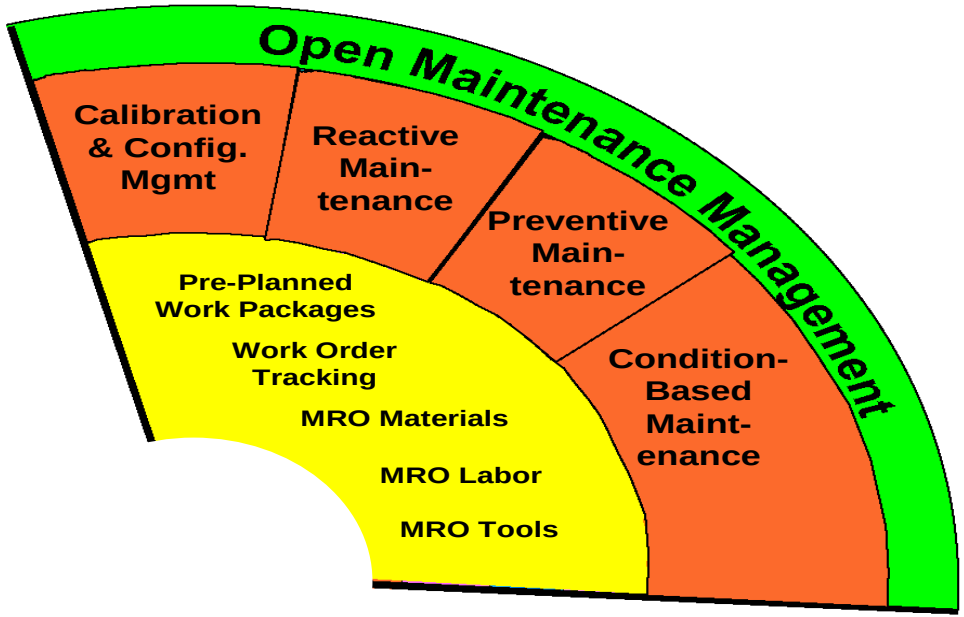
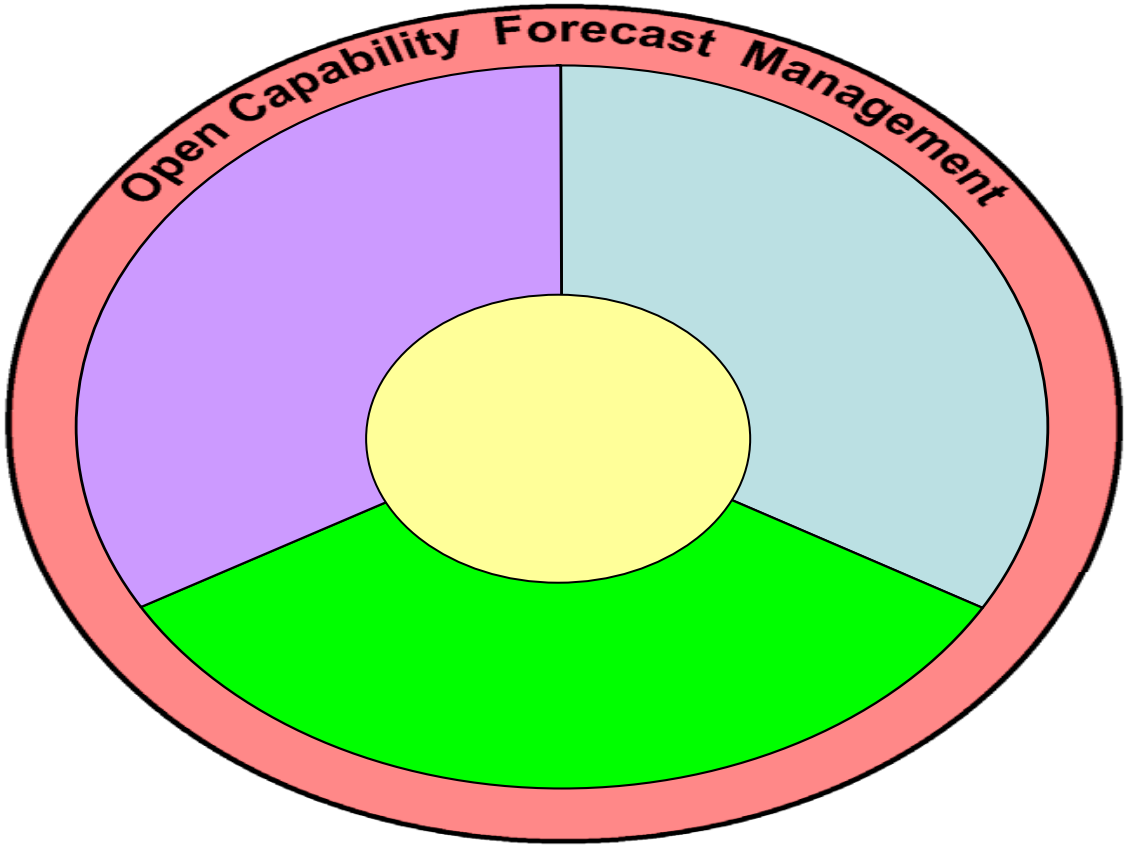


OSA-EAI Open Maintenance Management

- **MIMOSA Open Maintenance Management Information Standards**
  - **Provide a consistent information architecture for managing all maintenance information in an open, distributed, multi-vendor, multi-system environment**
  - **Based on MIMOSA's physical asset registry**
  - **Fully supports Predictive Maintenance (condition-based), as well as Preventive (time/usage-based), and Reactive (failure-based)**
  - **Supports pre-designed work "solution packages" which may be requested by an intelligent agent**
  - **Tracks MRO discrete parts, consummables, labor, and tools related to maintenance work orders (V3.2)**
  - **Supports complete tracking and close-out of work orders**
  - **Enables an exchange of maintenance related information between an unlimited number of distributed maintenance related systems with their own native systems architectures**
    - **All systems (platforms) to all maintenance management systems**
    - **All condition management systems to all maintenance management systems**
    - **All maintenance systems to all reliability management systems**

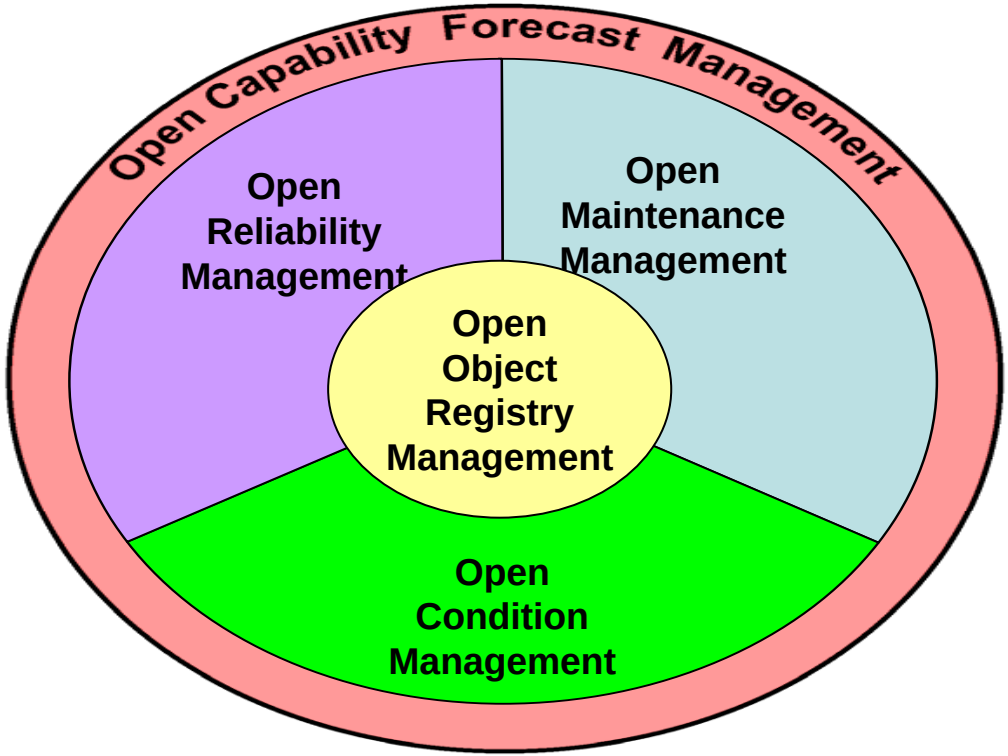
OSA-EAI Open Capability Forecast Management



OSA-EAI Open Capability Forecast Management

- **Provides a consistent information architecture for physical asset capability forecasting based on projected future operating profiles, quality constraints, and time constraints managing all physical asset capability forecasting information in an open, distributed, multi-vendor, multi-system environment.**
- **Supports operational forecast scheduling and what-if order/mission decision support**
- **Key enabling technology for the real-time enterprise along with raw material availability, personnel availability, and product storage capability forecasting assessment**

MIMOSA Open Systems Architecture for Enterprise Application Integration (OSA-EAI)



MIMOSA Open Systems Architecture for Enterprise Application Integration (OSA-EAI)