

AP239 Tutorial

Patrick Walsh
Enterprise Interoperability Standards
The Boeing Company
RROI #22-174407-ETT



Patrick L Walsh

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- **Patrick is a recognized expert in Boeing for the use of Industry Standards for interoperability, Business and Information Architecture modeling, and BCA Electrical Standards.**
- **He is currently the chair of the PDES Technical Advisory Committee, the co-leader of the ISO AP239 edition 3 project, and the vice chair of the ASD DMEWG PLCS TT working to integrate the data models of AP239 with those of the S Series Common Data model.**
- **His prior work includes managing business taxonomies for Boeing's digital transformation, developing XML management systems for CATIA automation projects, and developing solutions for Electrical part selection systems for the 787 program, including integrations with the Boeing Product Standards systems.**

What is AP239?

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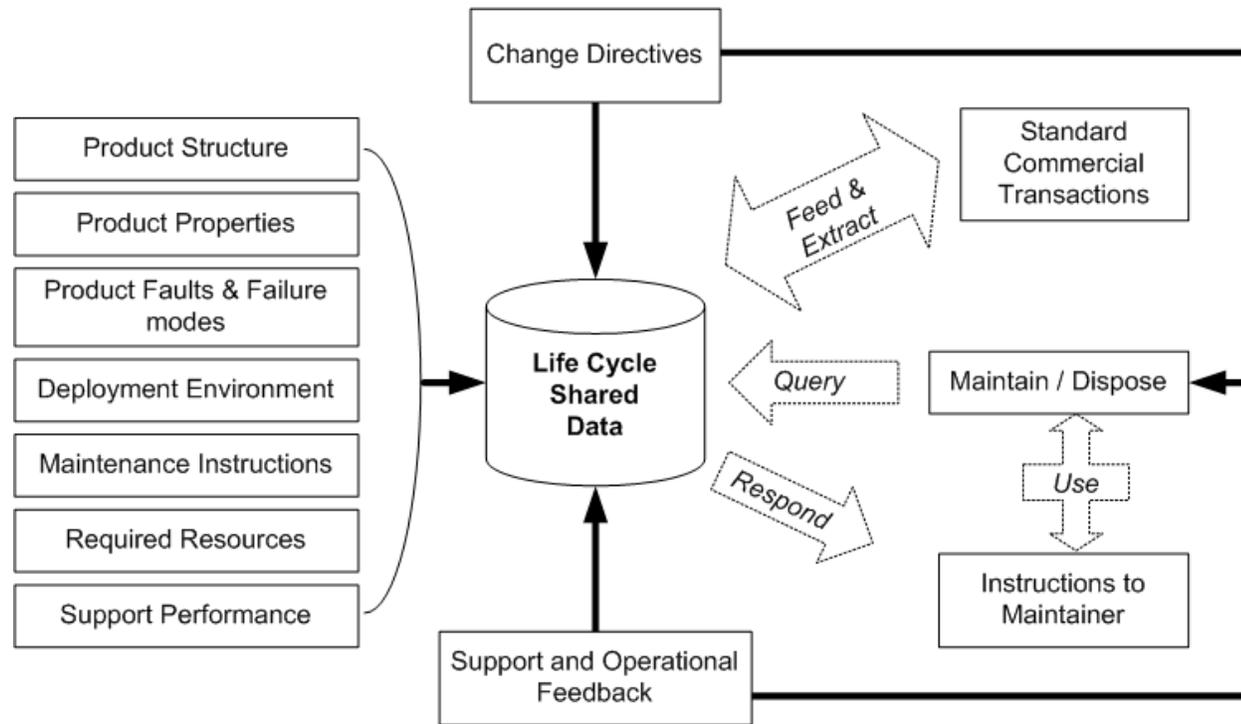
- ISO 10303-239 (AP239) is a ISO 10303 standard application protocol that defines the context and scope for product life cycle support (PLCS). It supports data exchanges and the integration of product support information needed to sustain fielded products in an operational condition.
- It references a companion AP module (AP 439) that specifies the information requirements and integrated resources necessary to support it.
- The main purpose of AP239 is to address the key business problem “How to keep the information needed to operate and maintain a product aligned with the changing product over its life cycle in a heterogeneous organization, process and system environment?”

AP239 Vision – The Big Idea

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In AP239, lifecycle data consists of:

- Assured set of Product and Support Information (APSI), with configuration management
- Related information such as feedback on product, activity, and resource history data.



AP239 can standardize interfaces for software applications in this context, for example:

- point-to-point interfaces between systems with similar capability and different application software
- point-to-point interfaces between systems with different capability, but some common data

AP239 provides a series of interfaces to realize integrations across many different systems

AP239 Basic Concepts

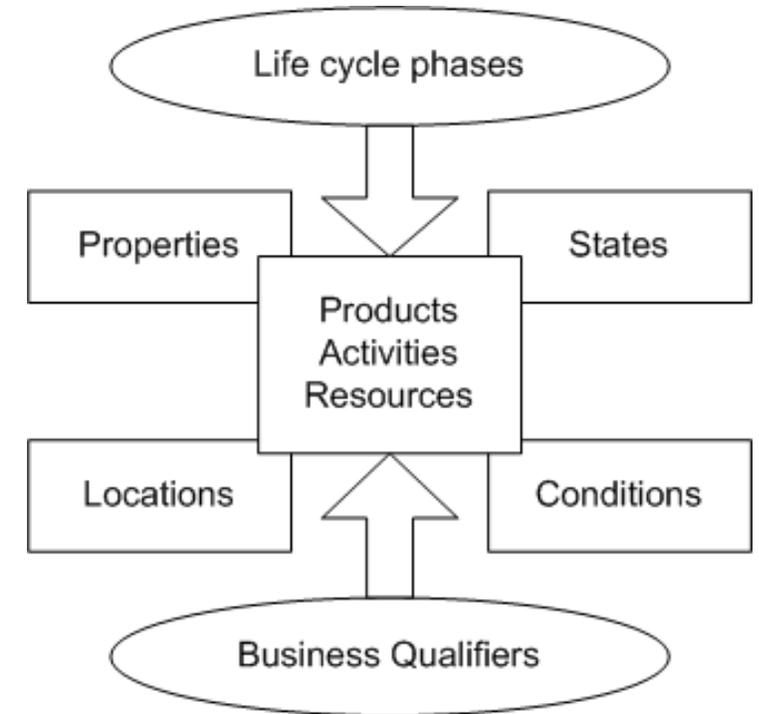
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AP 239 has three central concepts, Product, Activity, and Resource.

Each concept can be associated to Properties, States, or Locations, to which Conditions can apply.

AP239 entities, attributes, and relationships can be qualified by applying:

- Classifications, with options to use external class libraries or reference data
- Characterizations, to capture who defined a value and under what circumstance
- Justifications, to capture the rationale for a value or a relationship. Justifications can be classified and characterized.



AP239 is a container for Product, Activity, and Resource data throughout a product's lifecycle.

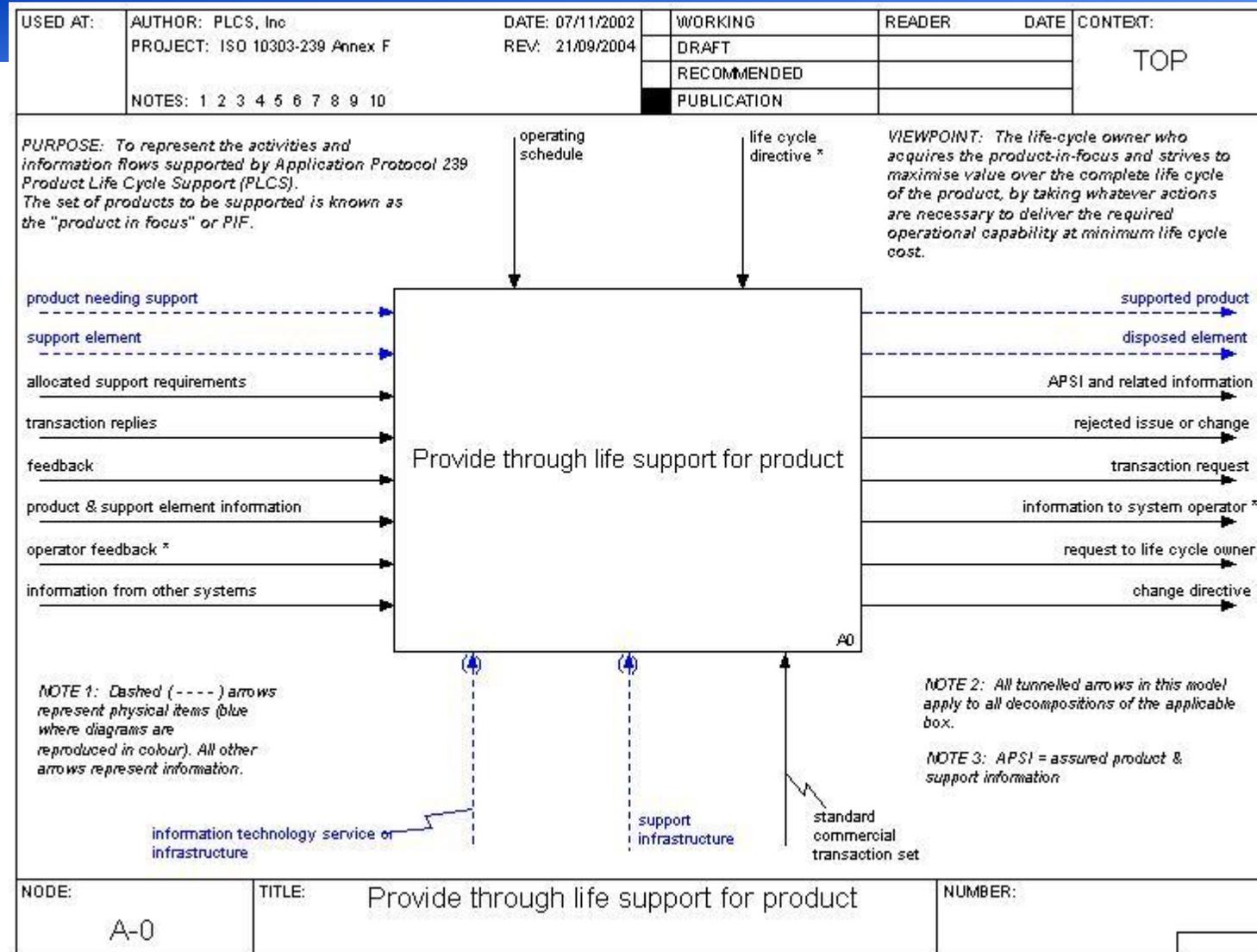
AP239 Scope and Business Concepts

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AP239's scope covers the most complex products and support requirements

Product Complexity	High	Missiles Satellites Ordnance	Business Aircraft Special Ind. Equipment Telecom Switchgear Aircraft Engine Avionics	Military Ship Commercial Ship Military Aircraft Commercial Aircraft Submarine Power Plant Oil Production Rigs
	Medium	Computers Leisure Vehicles Radio/Radar	Automobiles Transmissions Special M/c Tools Agricultural Machinery Engines	Power Turbine Mining Equipment Trucks Landing Gear Elevators Process Plant Army Vehicles
	Low	Domestic Appliances Consumer Electronics Bicycles Exhaust Systems	Boats Lawn Equipment Rail Cars Transformers	Pumps Valves Filters Brakes
		Low	Medium	High

Support Complexity

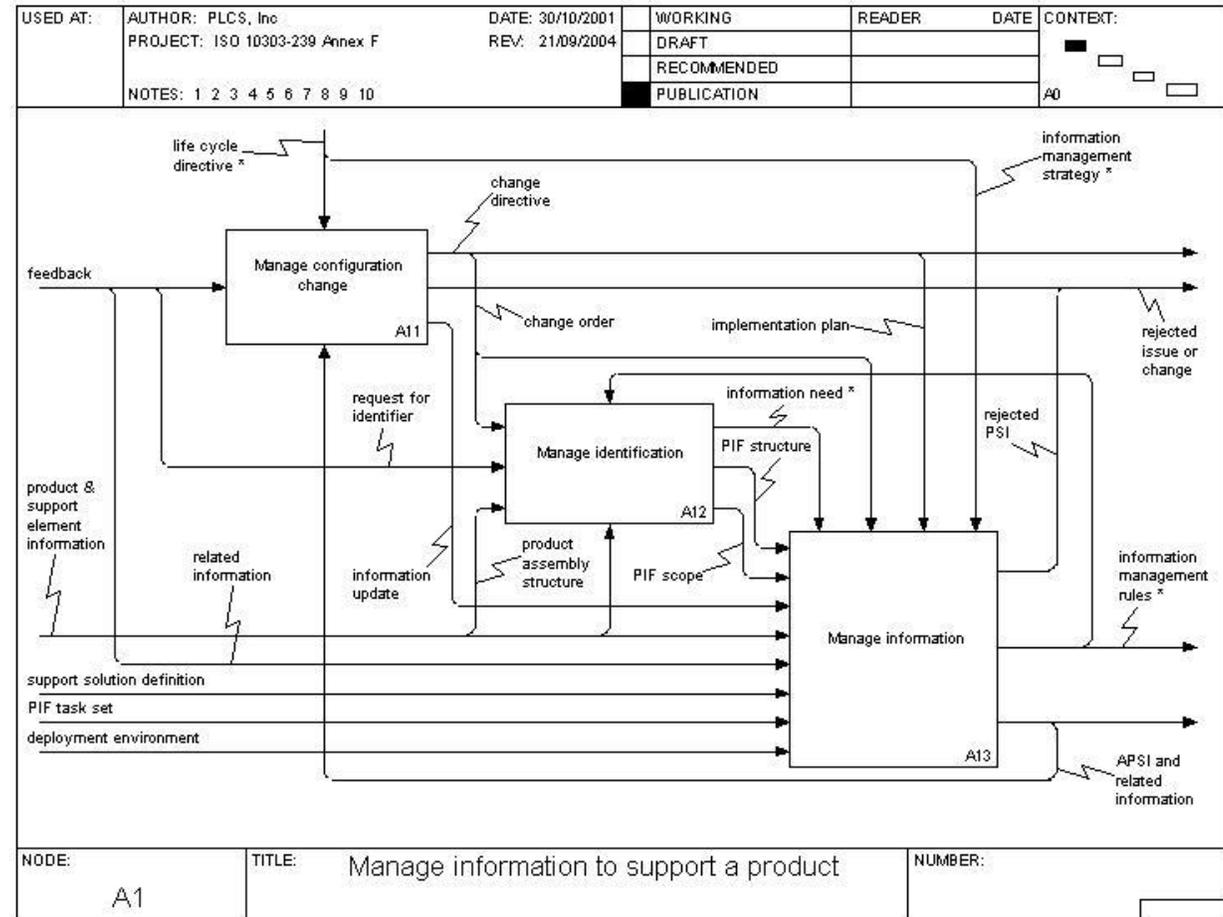


AP239 Major Use cases start with Managing Information

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There are 4 major use cases for AP239

- Manage information to support a product
- Generate support solutions
- Commission support system
- Provide support.

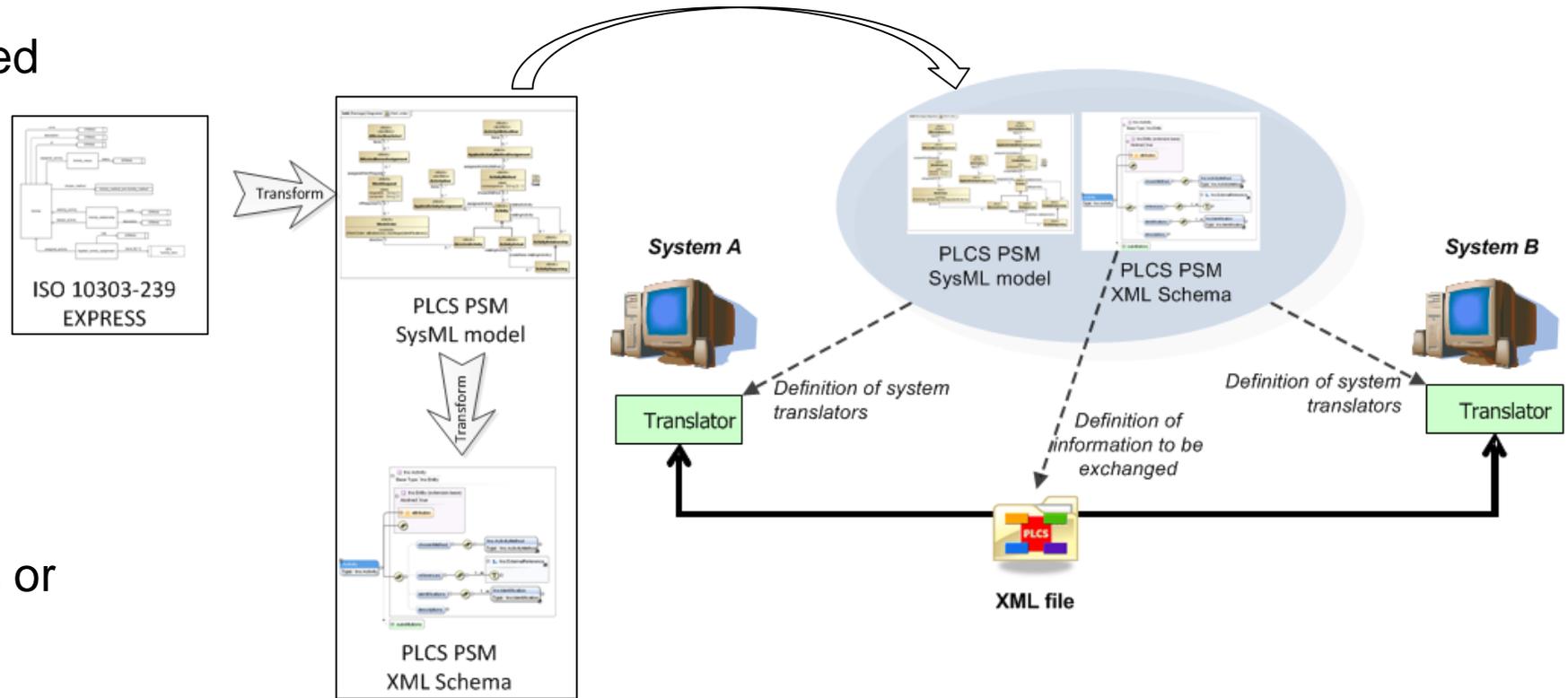


“Managing Information To support a Product” defines how AP239 supports Digital Threads

Managing Information using PLCS Platform Specific Model (PSM)

Since ISO 10303-239 is maintained using the EXPRESS data modeling language, the PLCS PSM was created as a transform to SysML of the original EXPRESS to support application software implementations

1. EXPRESS is transformed into SysML to make the PLCS PSM
2. The SysML can then be transformed into XML Schema
3. XML Schema will then define the XML-based format for the data exchanges at interfaces or other translator technologies.



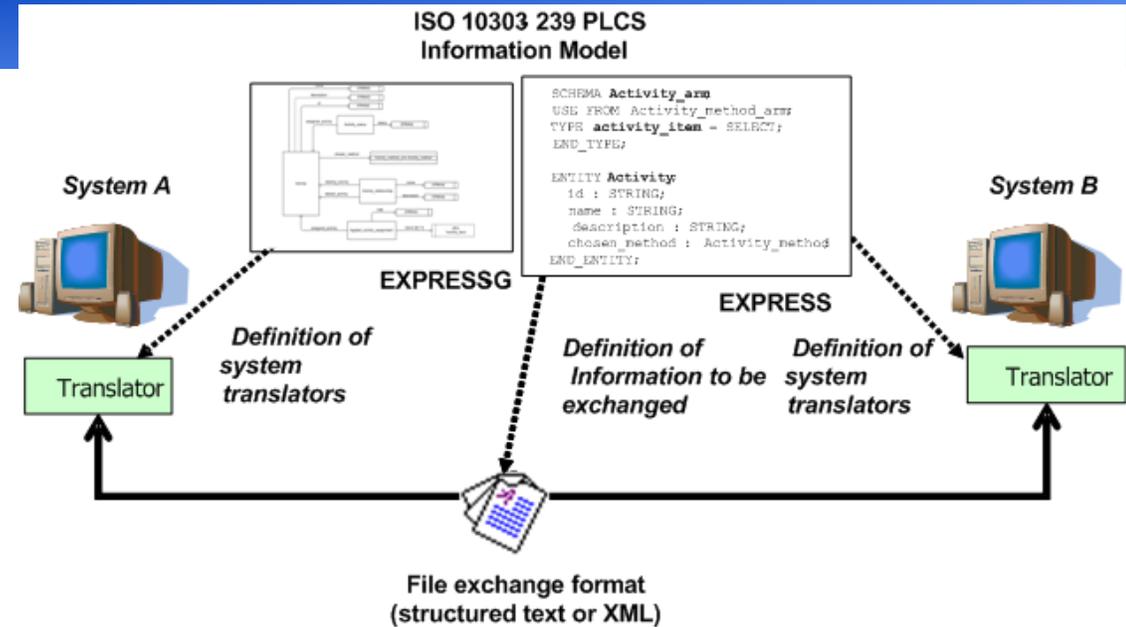
AP239 edition 2 adopted OASIS recommendations, AP239 edition 3 directly incorporates SysML models

AP239 reference approach for PLCS Data Exchange implementations

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The key components to implement an PLCS based data exchange are:

- Capabilities
- Data Exchange Specifications (DEX)
- Templates
- Reference Data



Capabilities provide usage guidance, each capability specifies Templates and DEXs for use.

DEXs were defined in the OASIS PLCS specification to define constrained and implementable subsets for use in implementations, since the scope and data model are wider than those of typical software applications

Templates are a named group of PLCS objects to instantiate a business object representation

Reference Data is the result of a SysML-based classification scheme to enable semantic precision when extending or specializing the definitions of classes or objects in the data model.

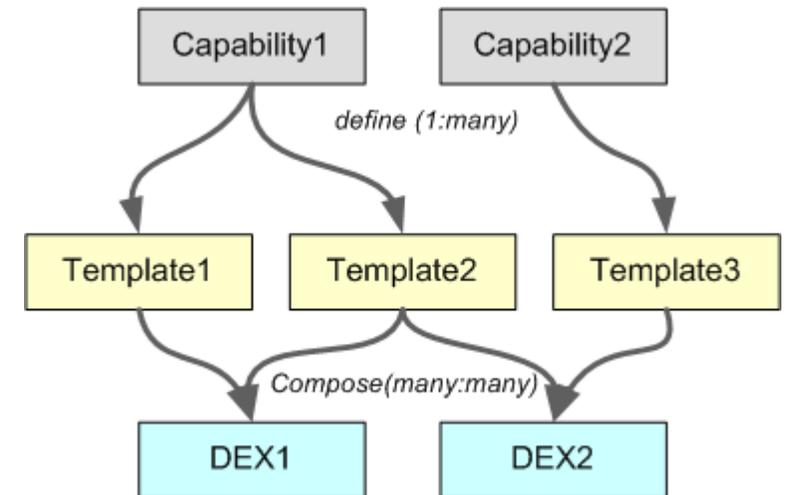
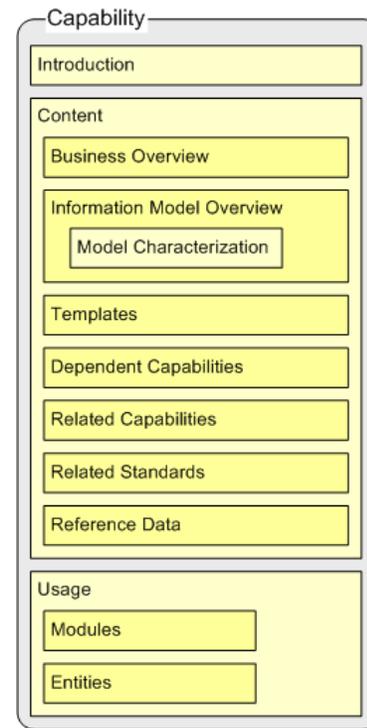
What are Capabilities?

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Capabilities provide guidance on how the PLCS information model and associated Templates and Reference data should be used. The concepts represented in the Capabilities are generic business level concepts (such as a "part" or an "approval") with an agreed to meaning.

Capabilities:

- ensure a common interpretation by using templates
- avoid multiple dialects
- reduce the amount of guidance documentation for those wishing to use only parts of the data model
- simplify instantiation



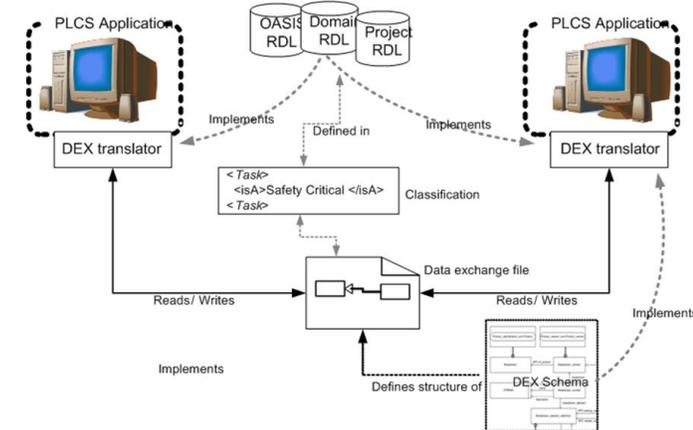
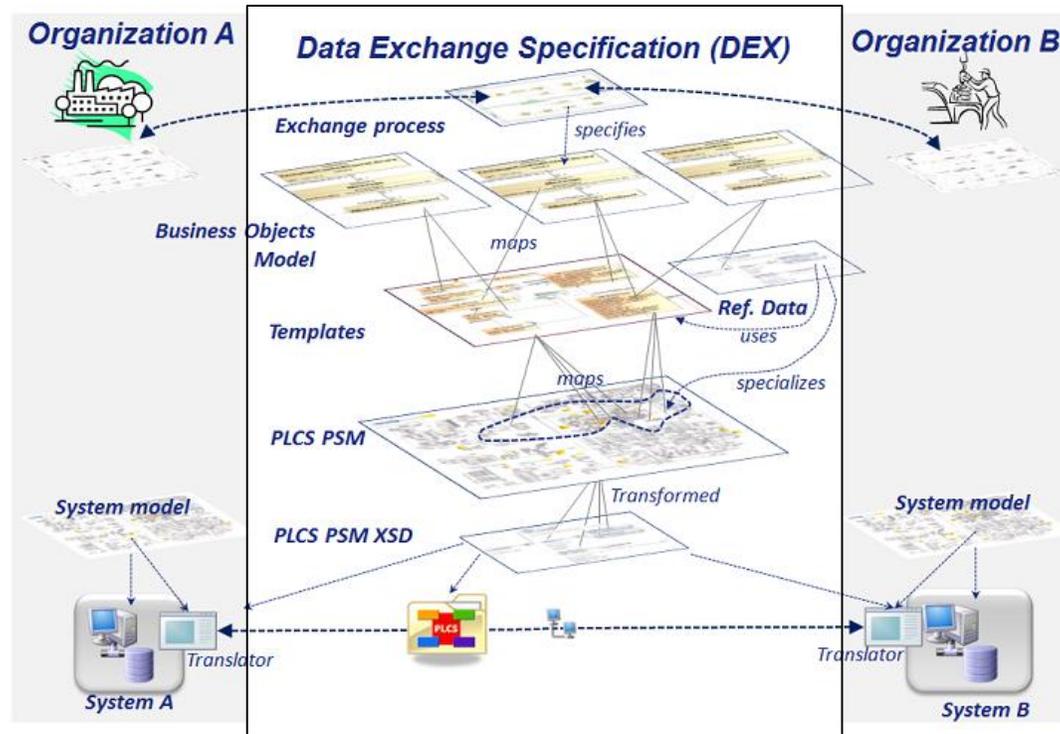
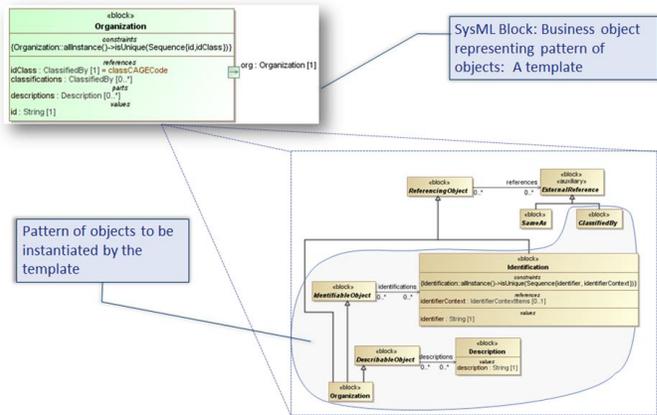
Part of OASIS recommendations per Annex H of ISO 10303-239 edition 2

PLCS DEXs, Templates, and Reference Data

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Using Capabilities, DEXs select a subset of PLCS PSM information model needed for the specific activities of the exchange, using templates and extending selected entities as needed by using Reference Data.

A Template is a named grouping of objects



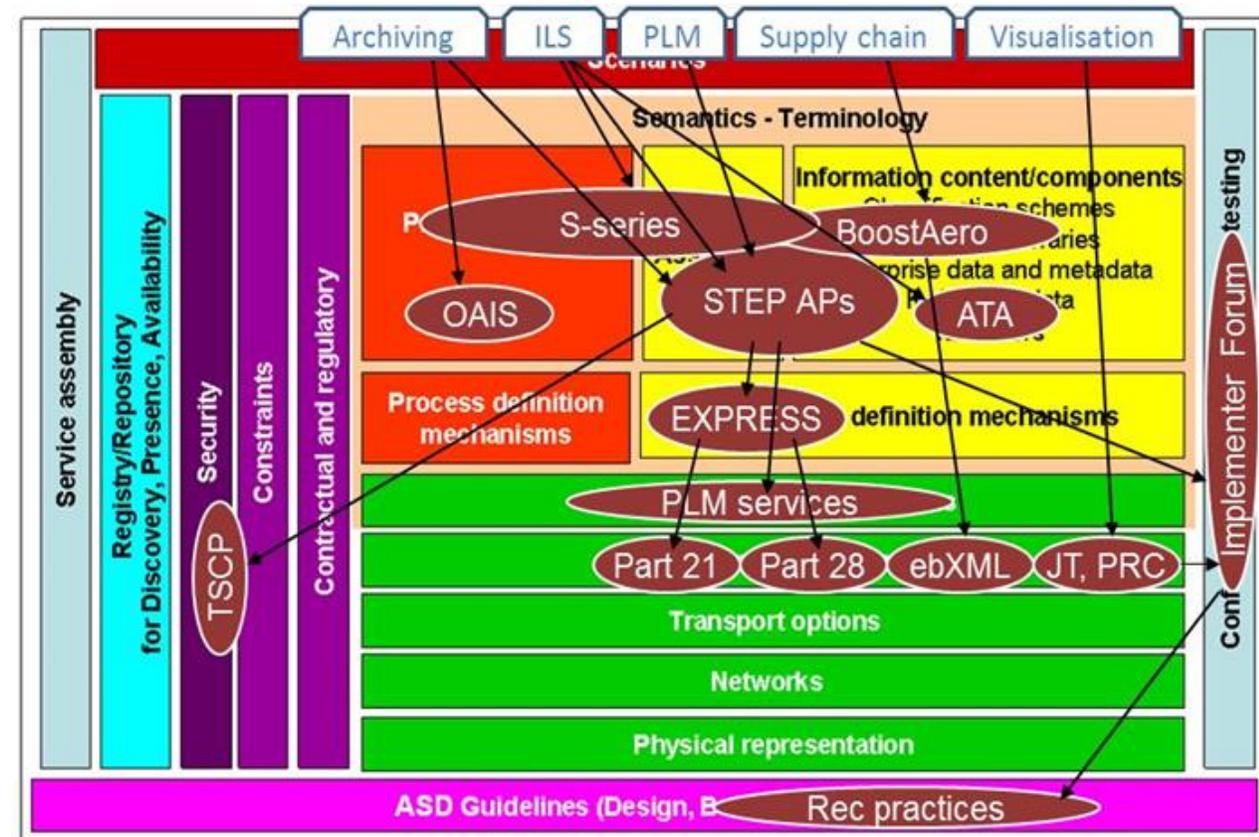
Reference data enable using semantics for specifying types of core model classes

Part of OASIS recommendations per Annex H of ISO 10303-239 edition 2

AP239 edition 3 Project Objectives, geared to improve Product Support

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1. **Strengthen the STEP architecture approach** to 1) ensure interoperability between STEP standards and 2) provide unambiguous implementation methods (including for new information technologies, e.g. OSLC).
2. Ensure that **3D visualisation format standards** used in the industry are **consistent with STEP standards**
3. Ensure the **common data model** for **ILS S-Series specifications** is **consistent with STEP AP239**.
4. Promote the **ASD-AIA ILS suite of specifications** and seek to manage **coherence with ATA specifications** where needed by the industry.
5. Participate in the development, and interoperability testing of the **next generation of PDM/PLM web services**.
6. Facilitate **data interoperability in the Aerospace and Defense Supply Chain** and align business process between Supply Chain stakeholders.
7. Supports the setting-up of **implementer forums** (e.g. PDM implementer forum) to test and validate the implementation of the standards-based solutions.



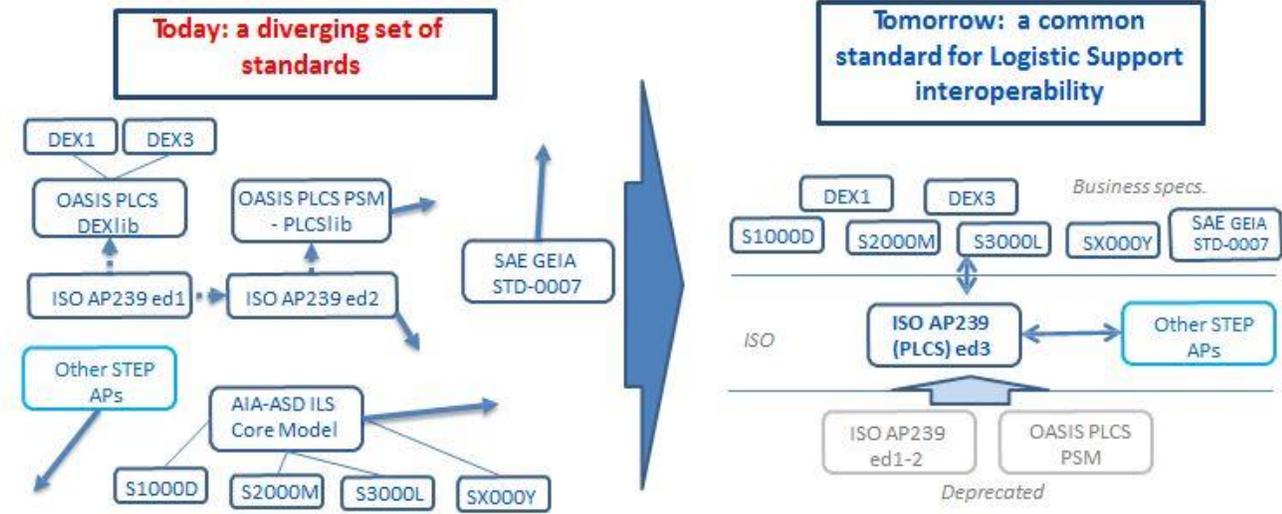
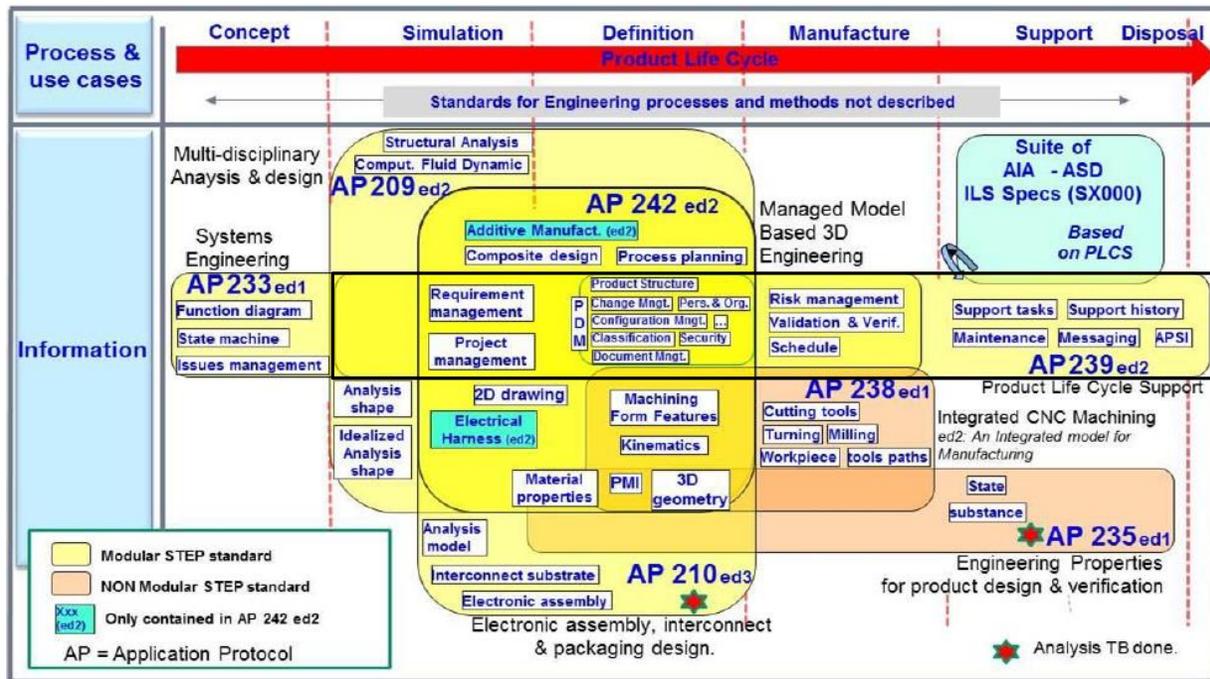
Source: AP239 white paper "ISO 10303 (STEP) AP 239 edition 3 Application Protocol For Product Life Cycle Support (PLCS)"

AP239 edition 3 Support for ASD ILS Specifications (DMEWG PLCS Task Team)

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AP239 support for ILS specifications is based on its integrations with the ISO 10303 STEP core model, shared with AP242.

Integrations with ASD ILS S Series specifications is a project supported by the DMEWG PLCS TT



ONE overarching standard, purposely adaptable to specific requirements and national legal contexts
 ONE standard to be implemented by IT Vendors (PTC, DS, Siemens, ...)
 ONE key standard to support interoperability « Through Life »

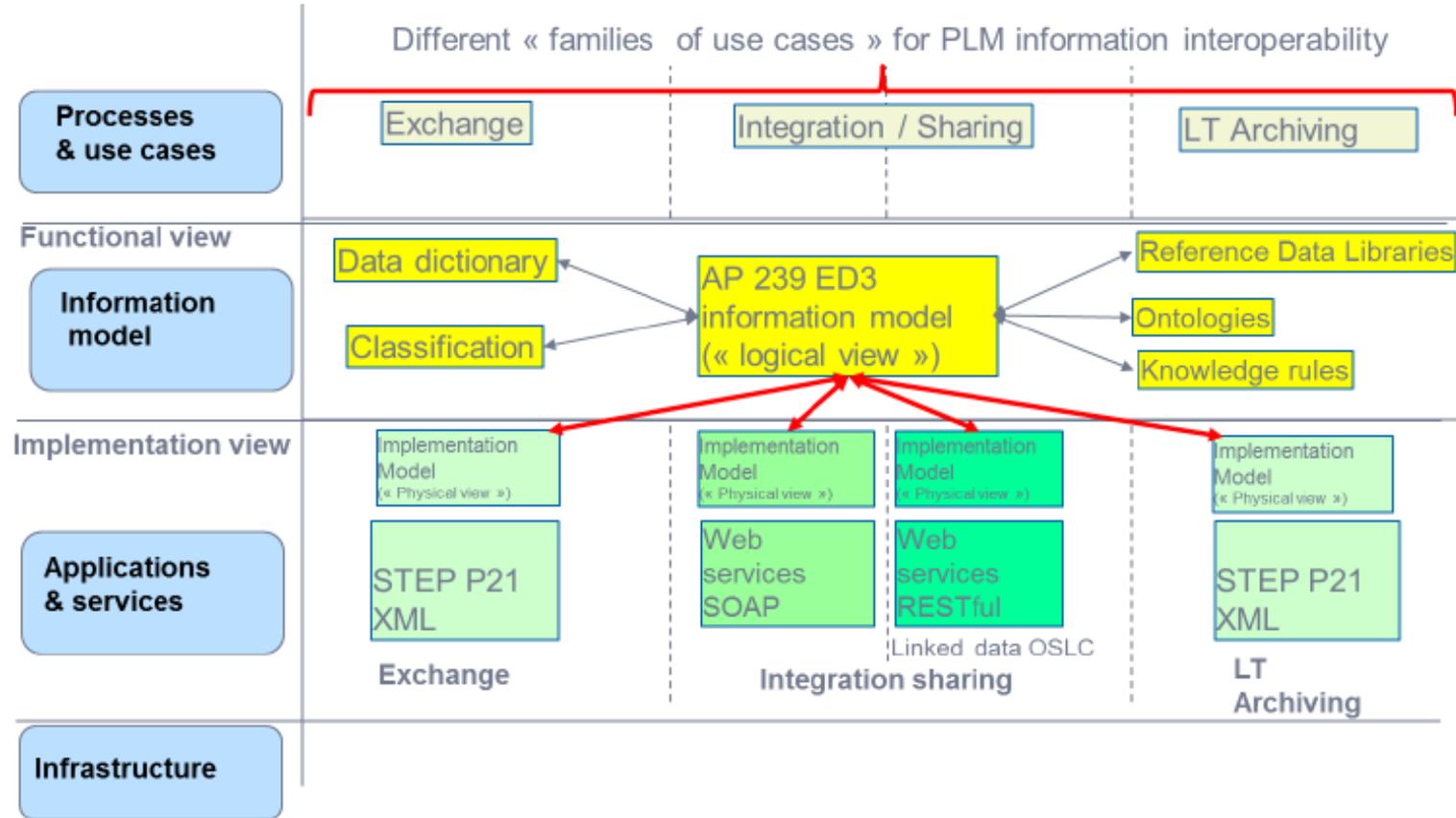
AP239 scope enables integration with standards in design, manufacturing, and support phases of the product lifecycle

AP239 edition 3 Architecture Framework

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Information model layer is designed to support a variety of business needs and implementations

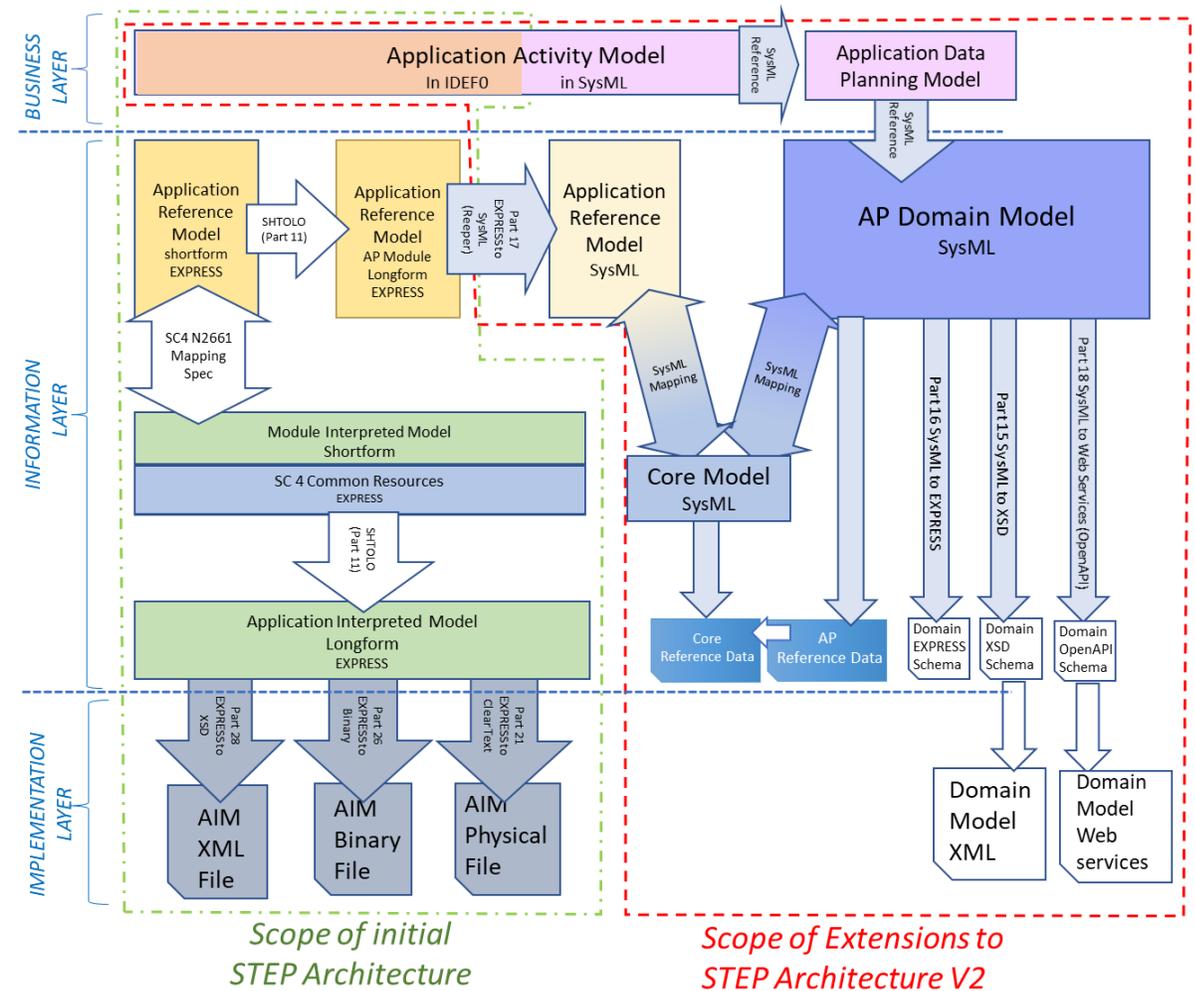
This is achieved by maintaining a clear separation between the functional view and the implantation views.



AP239 edition 3 use of Extended Architecture

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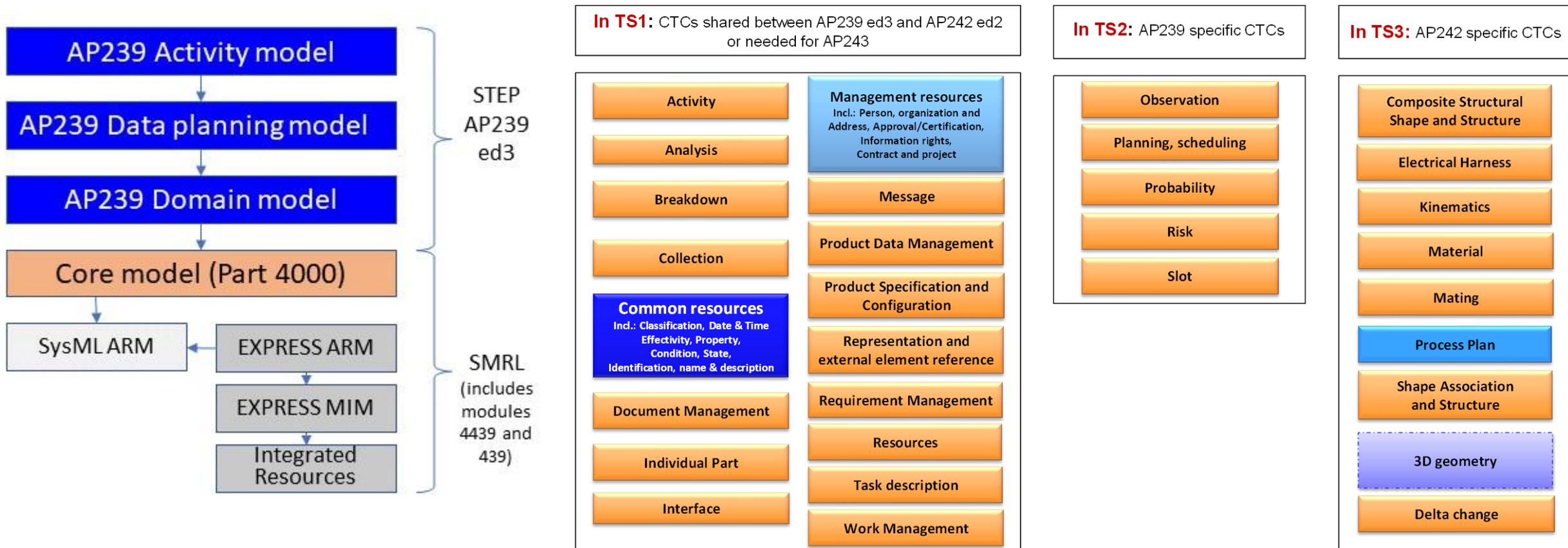
- Develop Core model and enhance the integrations with other STEP standards
- Adopt Extended architecture use of SysML Modeling
 - This enables interoperability across application protocols and other standards
 - Supports implementations to make use of xml and web services



AP239 edition 3 Core model work

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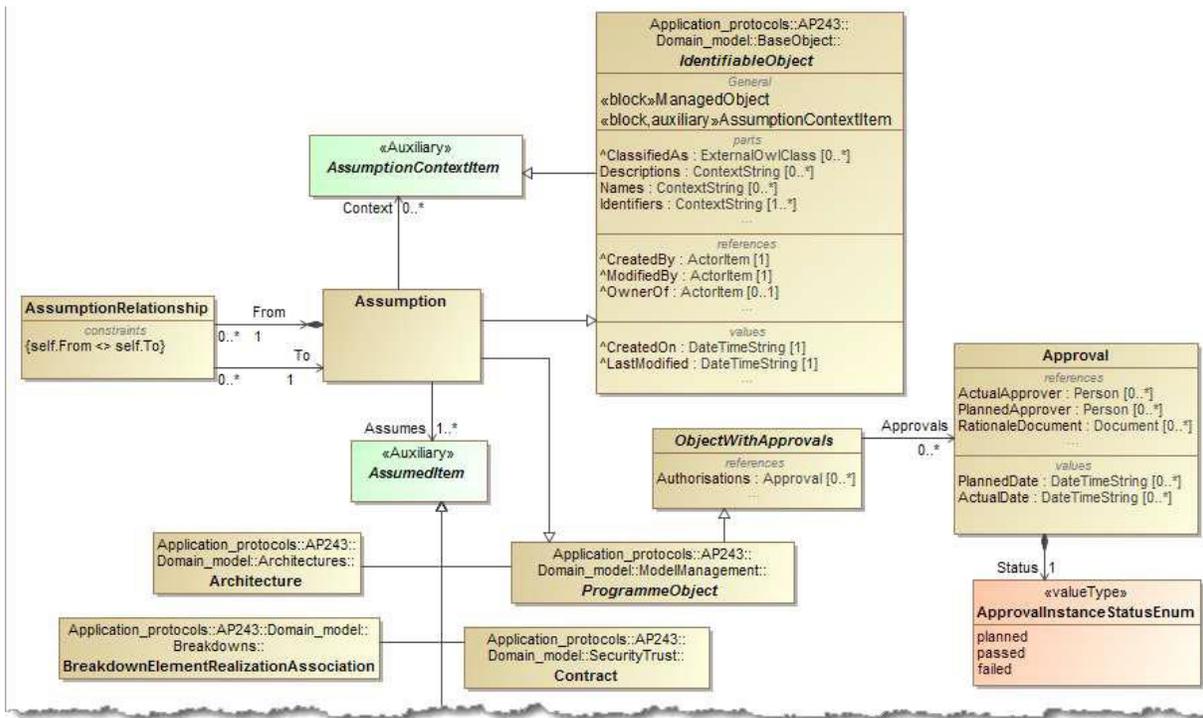
The Core model will be partitioned into a set of “Core Technical Capabilities (CTC) Mapping to the ARM is in SysML, and is being released as a series of ISO Technical specifications



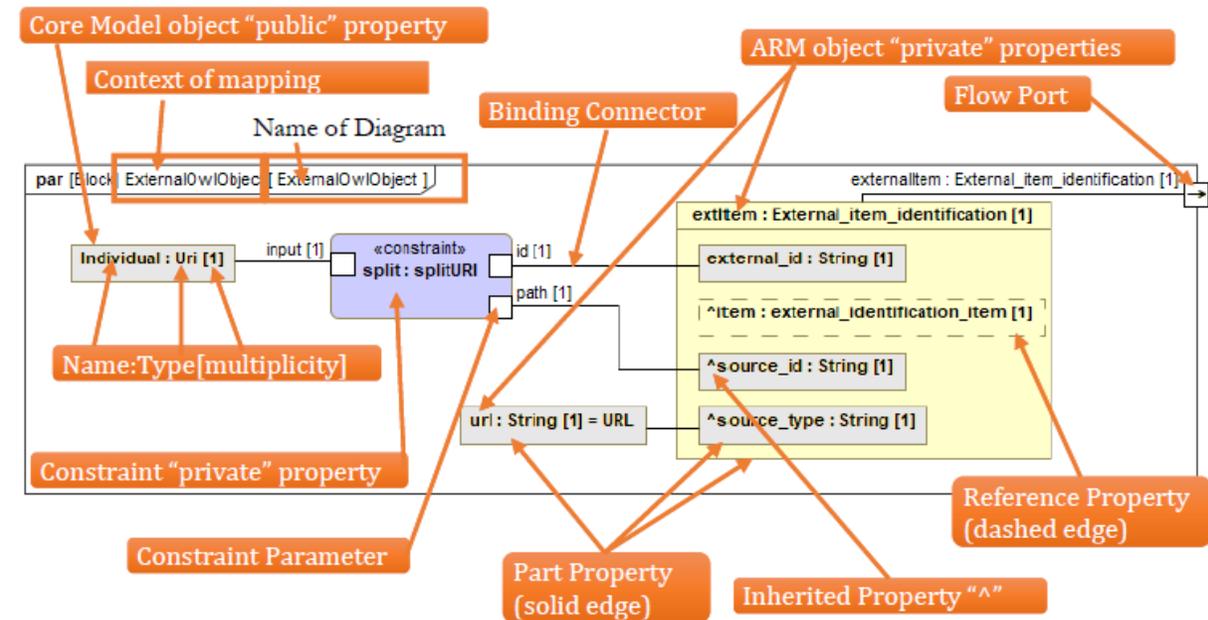
AP239 edition 3 use of SysML

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Information objects are modelled using the SysML constructs block, properties (value, part, and reference), constraints, and generalization.



SysML block definition diagram for an application domain model

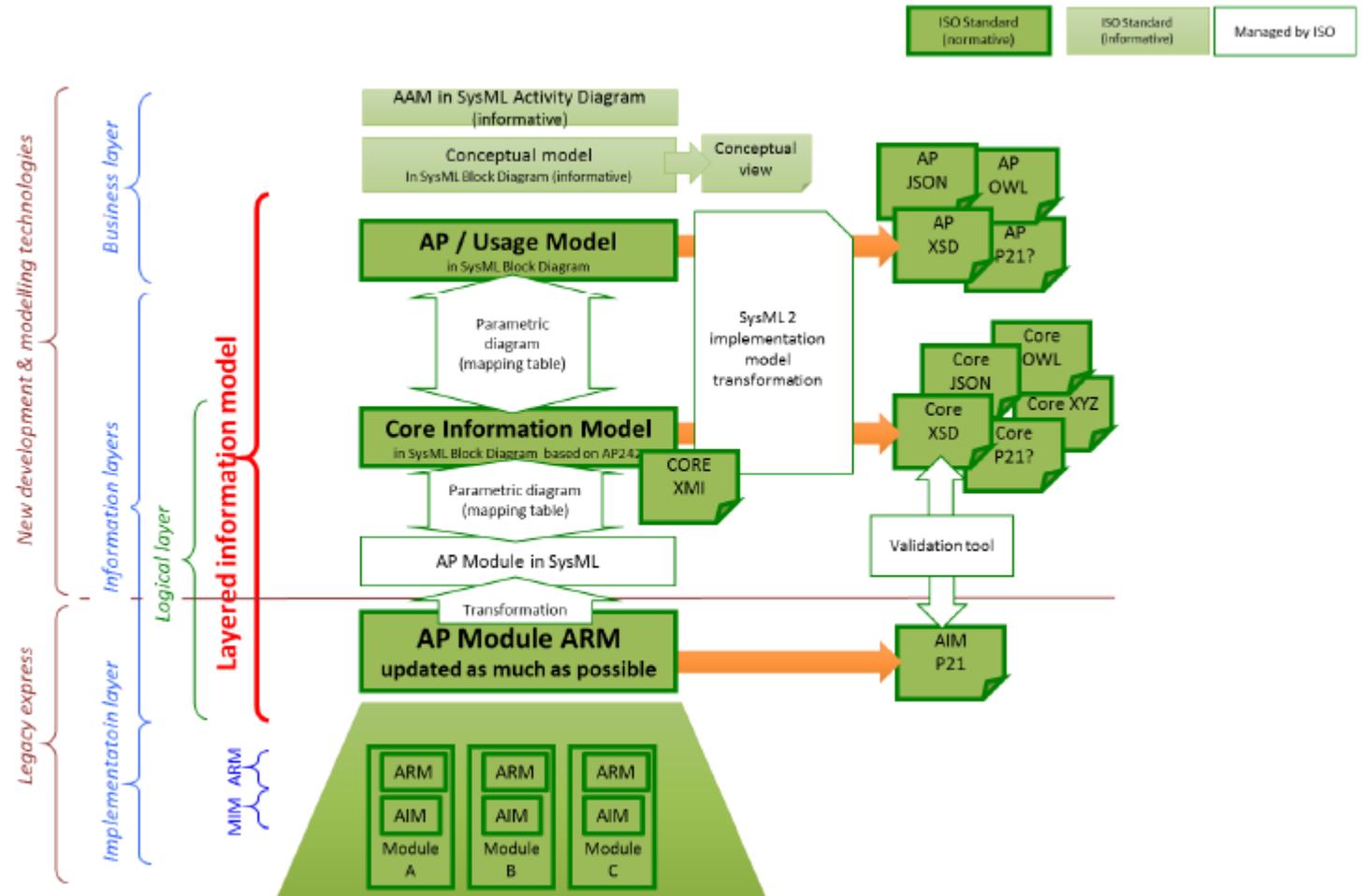


A parametric diagram mapping is “owned” by the source model Block object

AP239 edition 3 use of Extended Architecture and SysML models

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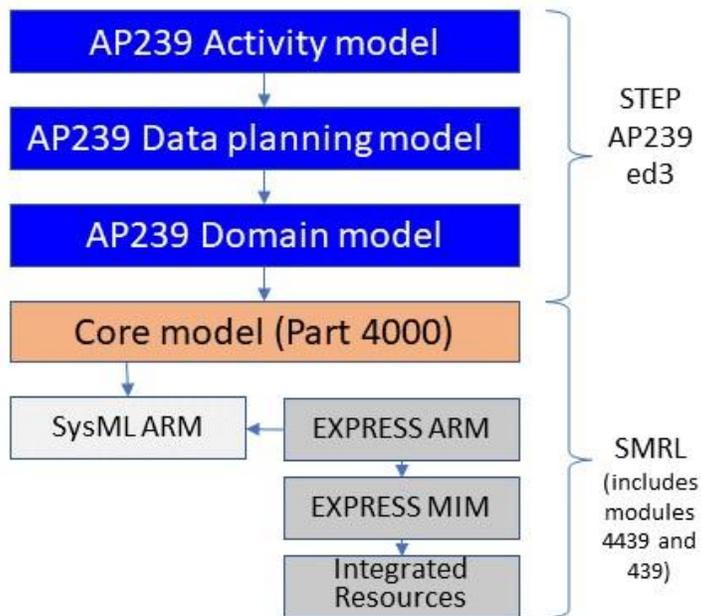
- Core model is in Express
- Everything that's relevant to AP239 is in SysML
- SysML provides a standard language format for:
 - Generating xsd schemas
 - Generating Reference data using OWL
- Enhances quality ease of managing model content in multiple formats



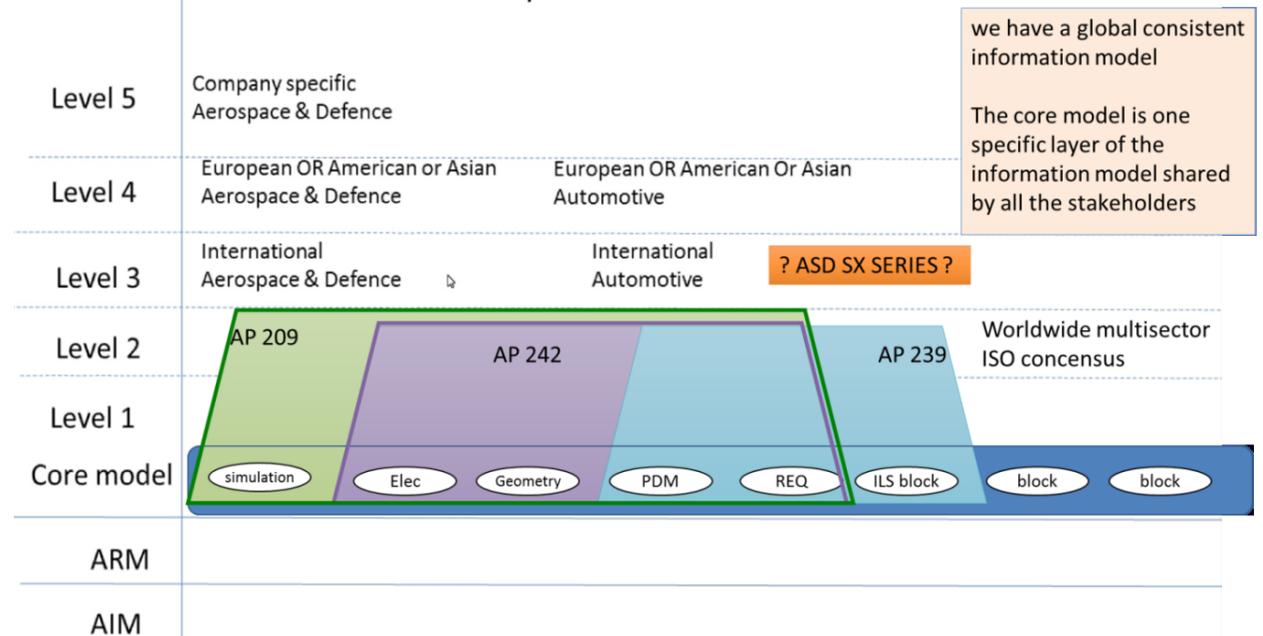
AP239 edition 3 Core Model mappings to business objects

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AP 239 edition 3 will reuse the PLCS templates to support development of high level business objects using the multi-layer information model
 Business objects in the higher levels identify consensus across industry stakeholders



Multi Information Model layer and associate stakeholders



Business objects defined in the ASD S-Series data model can be represented as business objects at level 3

Summary

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- **AP239 provides a series of interfaces to realize integrations across many different systems**
 - Can connect the data in the digital threads throughout the product lifecycle
- **AP239's scope covers the most complex products and support requirements**
- **AP239 supports Data Exchange implementations**
 - Supports numerous exchange formats
 - Covers all aspects of the product lifecycle
- **Integrations with other data exchange standards are implemented or in work**
 - Integration with AP242 through Core Technical Capabilities (CTC)
 - Integrations with S Series Product Support standards in work with ASD DMEWG
- **AP239 Edition 3 information model using SysML mappings to support many exchange formats**

Finally,

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Questions?

References:

ISO 10303-239:2012(E)

<http://www.ap239.org>

<http://www.asd-ssg.org/through-life-cycle-interoperability>

AP239 white paper "ISO 10303 (STEP) AP 239 edition 3 Application Protocol For Product Life Cycle Support (PLCS)"