

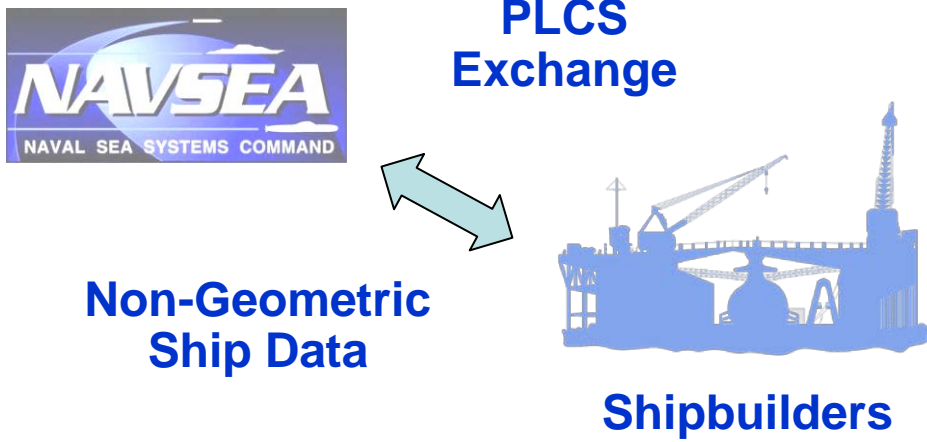


UNCLASSIFIED

PLCS DEX to exchange semantic information from ship STEP AP's

SBIR Topic Number: N091-052

Current PoP Ends: 12/23/2009

CONCEPT	DESCRIPTION/REQUIREMENT																																																														
 <p>NAVSEA NAVAL SEA SYSTEMS COMMAND</p> <p>PLCS Exchange</p> <p>Non-Geometric Ship Data</p> <p>Shipbuilders</p>	<p>Requirement/CAPABILITY GAP: Currently the Navy and shipbuilders only automate the exchange of geometric product data during ship design and construction. Product meta-data, such as product structure and material properties are transferred through manual processes which are time consuming and error-prone, which drives up the cost, risk, and time for developing new ships.</p>																																																														
<p>OBJECTIVE: Enable the Navy and shipyards to exchange non-geometric information regarding ship product models.</p>	<p>DELIVERABLE: Standard data models, interface adaptors, and software translators based on STEP AP239 PLCS for LEAPS and shipyard tools.</p> <p>TRANSITION(S): In Phase III to ship acquisition program.</p>																																																														
CONTACTS	FUNDING SUMMARY (\$K)																																																														
<p>Tech Sponsor: CAPT Jim Syring, PMS 500</p> <p>Tech Transition POR/Path: DDG 1000/OEM</p> <p>TPOC: Ben Kassel</p> <p>TPOC email: ben.kassel@navy.mil</p> <p>TWH:</p> <p>Contractor: CostVision Inc.</p> <p>Contractor POC: Charles Stirk</p> <p>Contractor email: stirk@costvision.com</p>	<table border="1"> <thead> <tr> <th></th> <th>FY 09</th> <th>FY 10</th> <th>FY 11</th> <th>FY 12</th> <th>FY 13</th> <th>FY 14</th> </tr> </thead> <tbody> <tr> <td>Phase I / Opt</td> <td>70</td> <td>30</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Phase II</td> <td></td> <td>300</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Phase II Opt 1</td> <td></td> <td></td> <td>300</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Phase II Opt 2</td> <td></td> <td></td> <td></td> <td>150</td> <td></td> <td></td> </tr> <tr> <td>CPP</td> <td></td> <td></td> <td></td> <td>??</td> <td></td> <td></td> </tr> <tr> <td>Phase III</td> <td></td> <td></td> <td></td> <td>??</td> <td></td> <td></td> </tr> <tr> <td>TOTAL</td> <td>70</td> <td>530</td> <td>400</td> <td>350</td> <td></td> <td></td> </tr> </tbody> </table>								FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	Phase I / Opt	70	30					Phase II		300					Phase II Opt 1			300				Phase II Opt 2				150			CPP				??			Phase III				??			TOTAL	70	530	400	350		
	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14																																																									
Phase I / Opt	70	30																																																													
Phase II		300																																																													
Phase II Opt 1			300																																																												
Phase II Opt 2				150																																																											
CPP				??																																																											
Phase III				??																																																											
TOTAL	70	530	400	350																																																											



NAVSEA-Shipyard Interoperability

- Non-geometric information transfer
 - Existing manual or custom processes
 - Ship STEP Application Protocols not supported by software vendors with translators
- Proposed solution
 - Use STEP AP239 Product Life Cycle Support (PLCS)
 - Harvest semantics of Ship STEP AP's
 - Enables use of open source or free development tools
 - Commercial tools available for implementation
 - PLCS software toolboxes for adaptors
 - Share-a-space collaboration hub for data mapping and consolidation



Modular STEP AP's

- Application Protocol (AP) Modularization Benefits
 - Standards as a Database
 - Faster revision process (months rather than years)
 - Interoperability of implementations through module reuse
 - Requirements, structure, etc.
- Modular AP Domains
 - AP203 Mechanical CAD (parts & assemblies)
 - AP209 CAE (FEA and CFD)
 - AP210 EDA/MCAD (electrical and mechanical assemblies)
 - AP233 Systems Engineering
 - AP239 Product Life Cycle Support (PLCS)



Mandates for ISO 10303 (STEP)

- requirement for **Computer-Aided Engineering, Design and Manufacturing** systems used by NASA to have **interchange tools that support ISO 10303**
 - NASA-STD-2817 Chief Information Officer (1999)
- “procure **all product/technical data** in attachment (1) digital formats and ensure product model data meets ISO/STEP requirements specified in attachment (1).”
 - ASN RDA Memo by John Young, Oct. 23, 2004, **STEP for 2-D and 3-D CAD**
- “**implement a similar approach** that adopts ISO 10303 to enhance interoperability” as described in Young memo above
 - OSD ATL Memo by Ken Krieg, June 21, 2005, **STEP for UID**
- “Ratifying nations agree to apply **ISO 10303-239 for product data management** in cooperative NATO acquisition programs.”
 - NATO STANAG 4661, ratified by US
- “The PM shall require the use of International Standards Organization (ISO) 10303, Standard for Exchange of Product (STEP) Model Data, **AP239, Product Life Cycle Support, for engineering data** “
 - AFI 63-101 , April 17, 2009, PLCS for engineering data

Product Life Cycle Support (PLCS)

Capabilities enabled by PLCS



Product Description

Capability to define product requirements and configuration, including relationships between parts and assemblies in multiple product structures (as-designed, as-built, as-maintained)

Work Management

Capability to request, define, justify, approve, schedule and capture feedback on work (activities) and related resources.

Property, State and Behaviour

Capability that describes and captures feedback on product properties, operating states, behaviour and usage

Support Solution and Environment

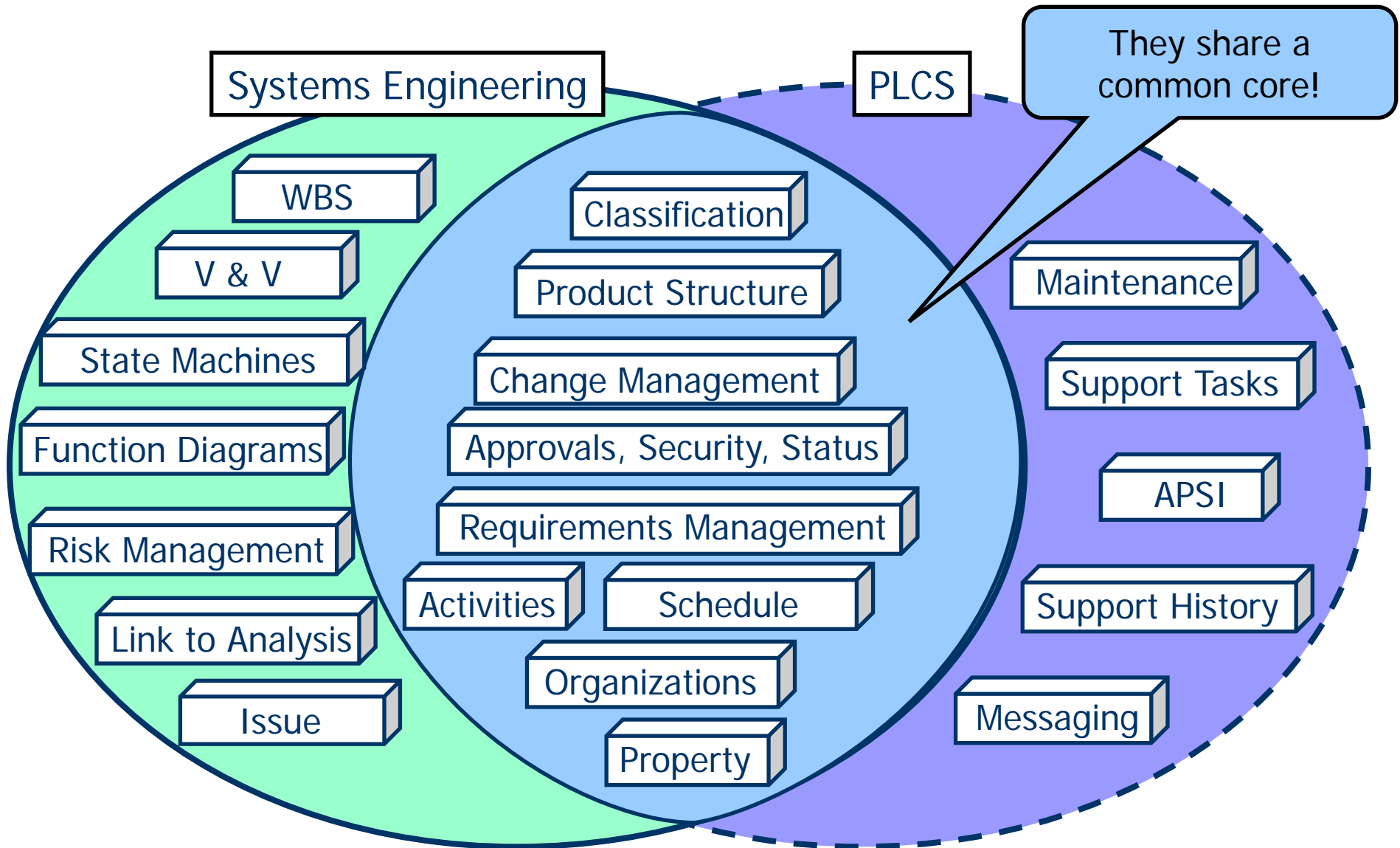
- Capability to define the necessary support for a given set of products in a specified environment and to define support opportunity, facilities, personnel and organizations

PLCS - Information modelling principles

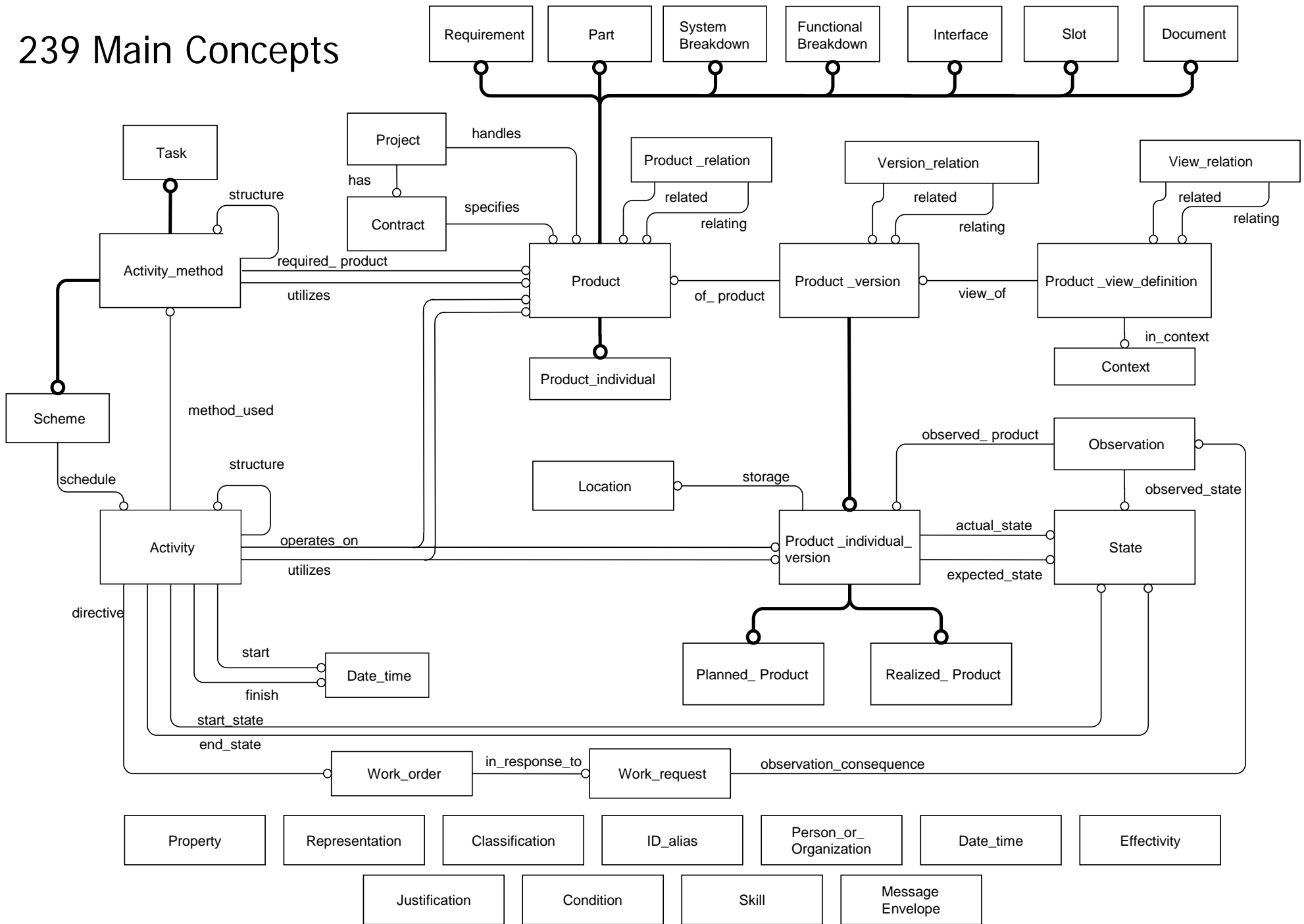
- Create a durable data model standard that can be extended/adapted over time without re-modelling or re-ballot
 - Identify key generic concepts and relationships
 - Extend/adapt by classification and reference data libraries
- Build on existing standards
 - PDM Schema and the STEP Modular Architecture
- Accommodate values that change over time
 - Support multiple values for the same property
 - Support back-tracking & audit
- Maintain unambiguous histories
 - Product Structure, State, Activity
- Aim: enable optimisation of support through life



Systems Engineering/PLCS Overlap



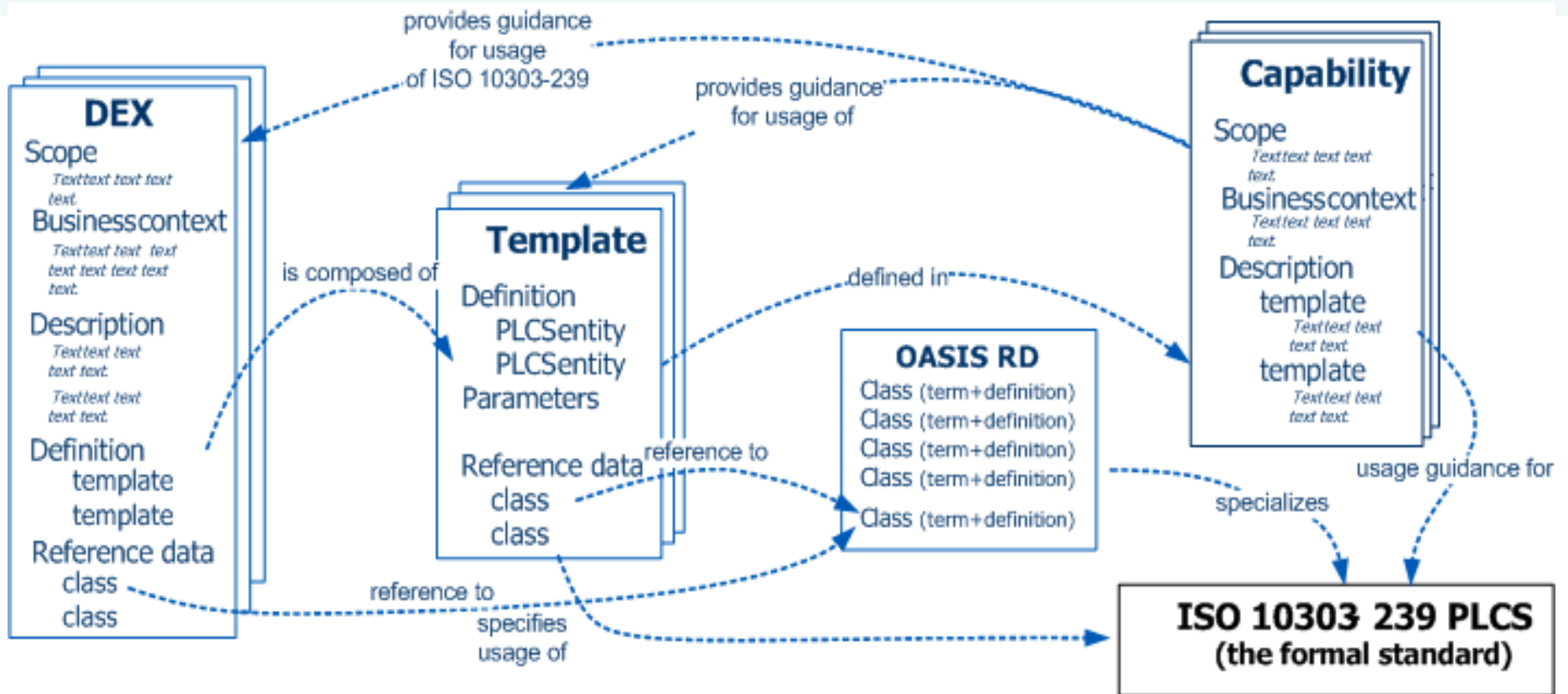
239 Main Concepts



Mapping with Reference Data

- Entities/relationships 233/239 are general
 - e.g. Product, Activity, Product_relation
 - Most entities are subtypes of Product
 - e.g. Requirement, Part, Interface, ...
 - Inherit structure and relationships of Product
- Other subtyping is by classification assignment
 - Specialization of entities/relationships/attributes
 - External classes of reference data
 - e.g. INCOSE subtypes for requirement_version
 - Functional, Performance, Reference, Validation, ...
 - Map to a domain by developing reference data

OASIS DEX Architecture



- Reference data in Web Ontology Language (OWL) tailors to domain
- Templates are assembled into Data EXchange Specification (DEX)
- Open source infrastructure and free development tools



Business DEX Development

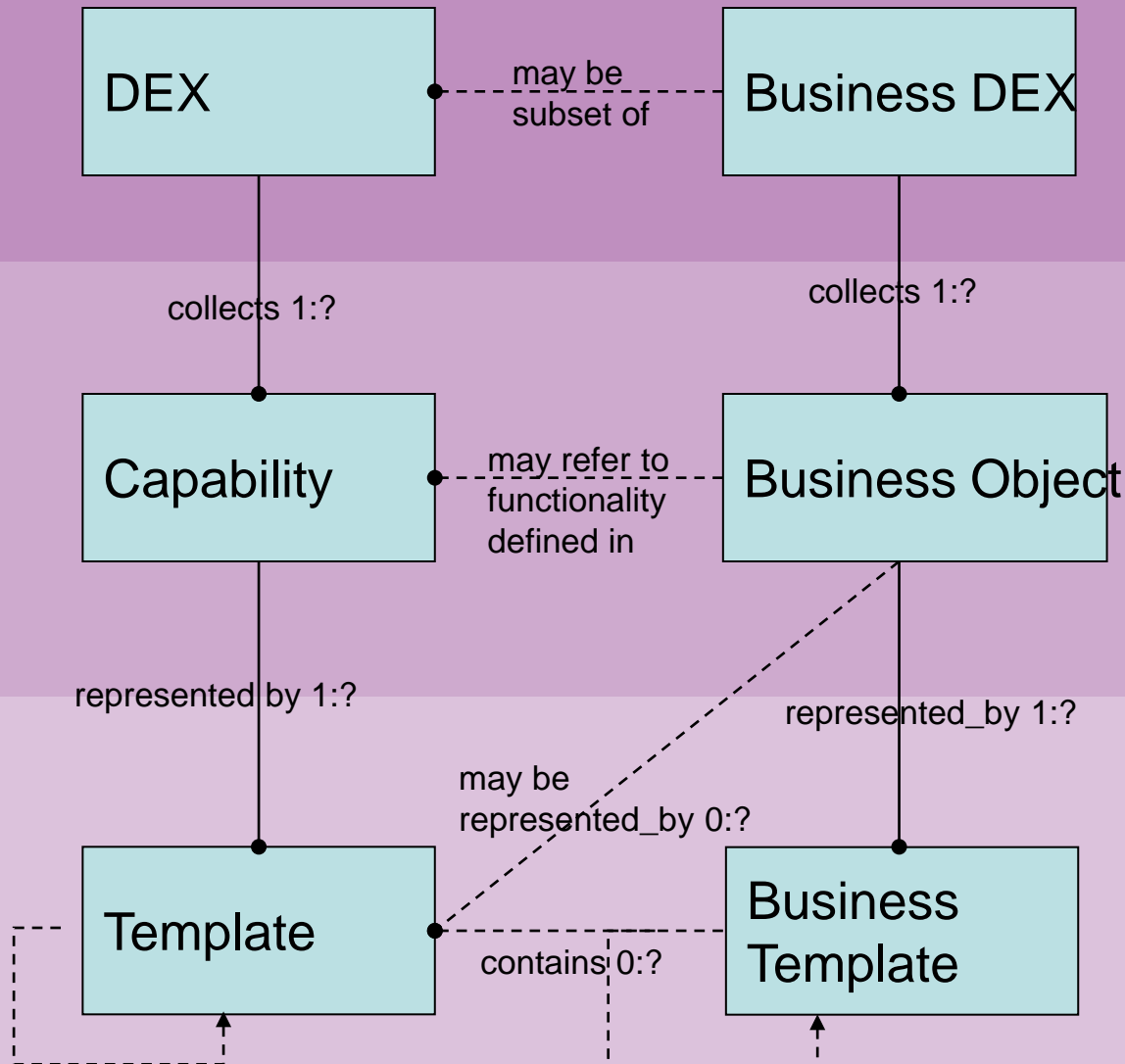
Domain Independent

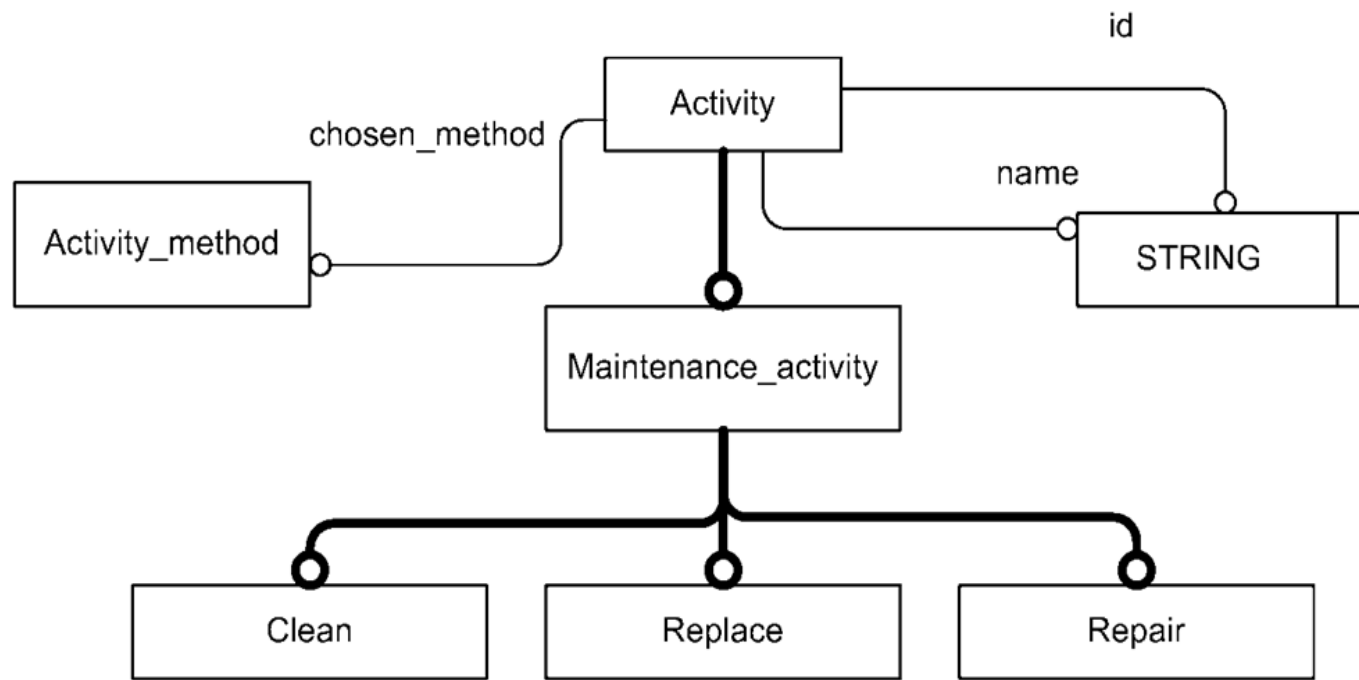
Business Dependant

Business process level

Business information level

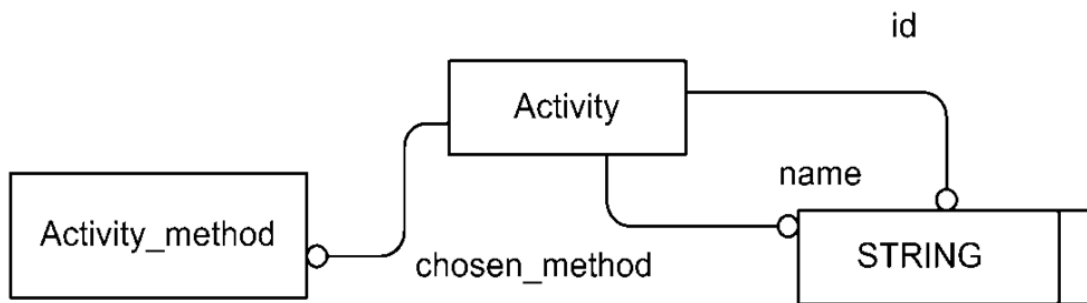
Implementation Level



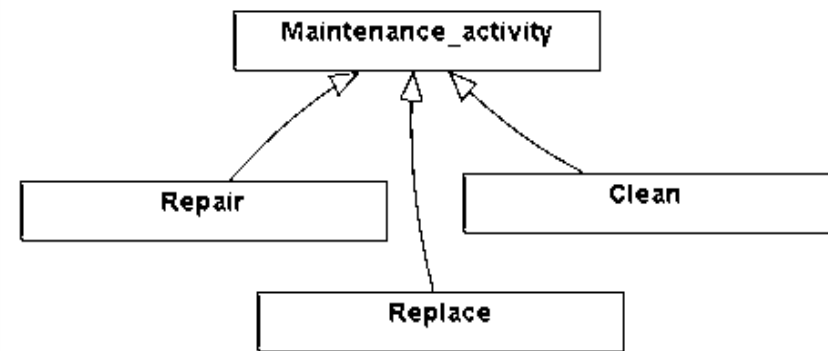


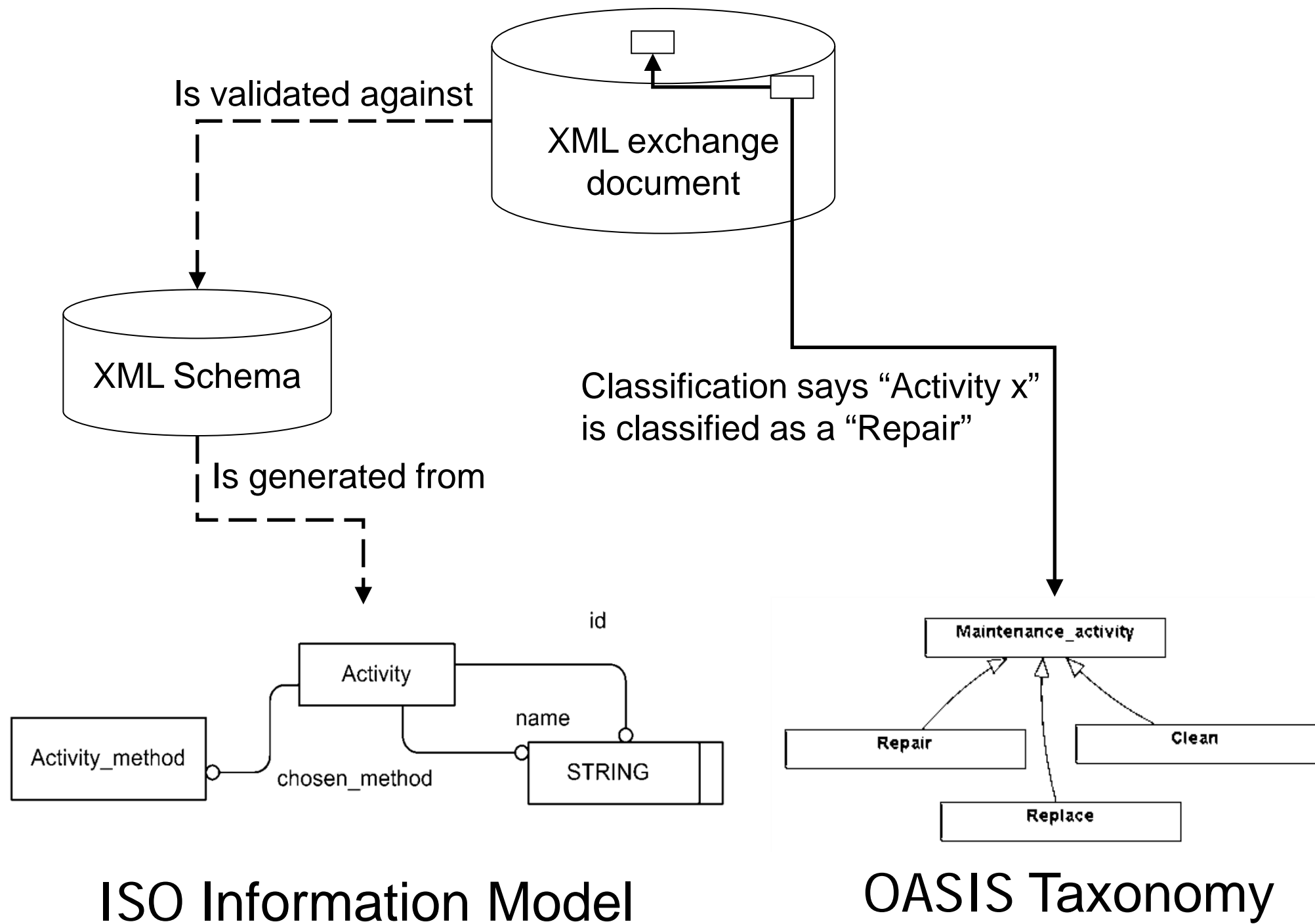
Extension by Subtyping

ISO Information Model



OASIS Taxonomy

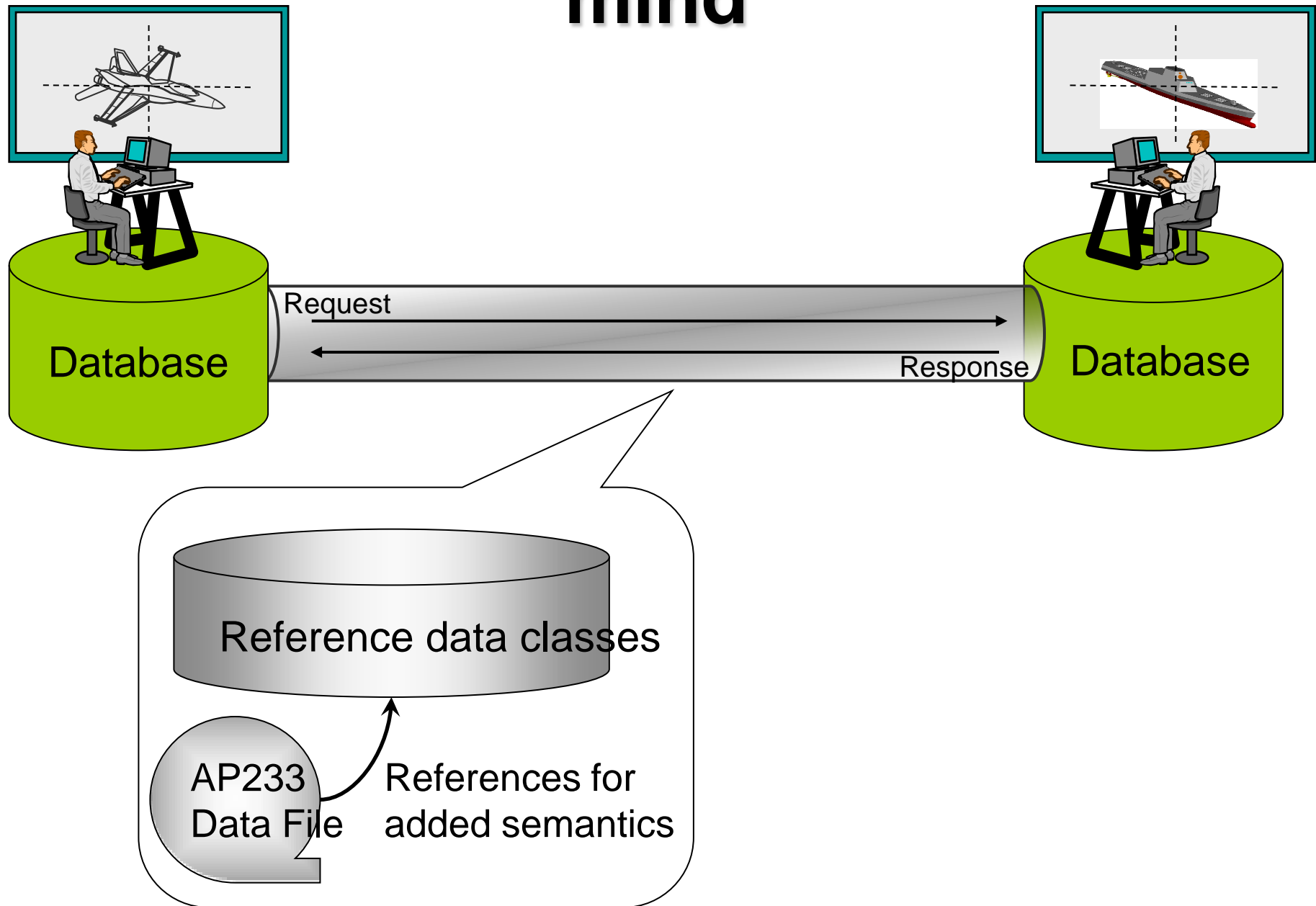




ISO Information Model

OASIS Taxonomy

AP239 designed with extensibility in mind





PLCS Implementers Forum

- Replicate success of CAX-IF for STEP CAD data exchange
 - Regular test rounds with focused cases
 - Recommended practices for implementers
 - Feedback to standards developers
- PDES Inc. exploring PLCS-IF
 - Start-up funded by DoD
 - Open access to vendors
 - Driven by user requirements



LOTAR International

Long-Term Archiving and Retrieval (LOTAR)

- 3D CAD and PDM data
- Information content
- Processes required
- Standards harmonization
- GD&T called-out
- Test at CAx-IF

Parties to Joint MoU

- PDES Inc.
- ProSTEP iViP
- Aerospace Industries Association (AIA)
- ASD-STAN (European Aerospace Standards)



PLCS: Relationship to other standards

- Current position
 - PLCS can use the data generated by current ILS standards
- The opportunity
 - PLCS can enable much higher levels of data integration
 - PLCS, and other factors, will drive change in most current ILS standards
 - The pace and direction of this change depends on market factors
- The challenge
 - To exploit the development of PLCS to deliver improved logistics services and capabilities



Convergence of AP203 (Aero) and AP214 (Auto)

- Create single superset standard for MCAD
 - 203 x 214 = 242
 - Modularization for interoperability across domains
 - Already harmonized for geometry (translators handle both)
- 214 adds the following capabilities
 - Manufacturing process planning
 - Relate plans, operations, tools, raw/in-process/finished, projects, other activities, etc.
 - Kinematics
 - Machining Features
 - Configuration Variants
 - OMG PLM Services (web services API) for Engineering Change
- Enable association with 203 unique capabilities
 - Catalog, Composites, Construction History, Requirements



New Functionality for AP 242

- 3D shape quality
- 3D parametric / geometric constraints design
- 3D kinematics assembly
- 3D GD&T at assembly level
- Sustainability information
- Access rights / Digital Rights Management
- Software / mechatronics
- 3D electrical harness
- 3D piping

- more -



Benefits of 242 For

- **Standards Developers**

- Eliminates overlapping development and maintenance
- Eliminates time consuming harmonization

- **Software Vendors**

- Upward compatibility for existing implementations
- Single standard so reduced cost and time to conform
- Combination of 203- and 214-unique capabilities can lead to new software capabilities

- **End Users**

- Unified approach to PDM exchange
- Interoperability with other domains such as CAE, PLCS, SE



Phase I Objectives

- Demonstrate the feasibility of software interface tools
 - Build PLCS DEX's
- Establish Phase II performance goals and key developmental milestones
 - Investigate LEAPS and shipyard design tools



Phase I Results

- Focused on information from Ship STEP AP227 Plant Spatial Configuration
 - Piping and HVAC distribution systems
- Built reference data for OASIS PLCS DEXlib standard templates
 - Semi-automated harvesting works quickly (20 entities/day)
 - Can be used for other models and Ship AP's
- Trained on Navy LEAPS and PLCS interface/translation tools
 - Developed XML Schema to map LEAPS XML output to



Phase II Objectives

- Map between LEAPS and shipyard tools to neutral data model
- Develop interfaces to LEAPS
- Develop interfaces to shipyard tools
- Demonstrate working prototype of exchange of non-geometric product data between Navy and shipyard



Phase III Commercialization Strategy

- Transition to use on a ship acquisition program
 - Shipyards that are sub-contractors on the SBIR
 - Northrop Grumman Shipbuilding
 - Electric Boat
- Provide software and services to US shipyards
- Through partner Eurostep, provide software and services to European shipbuilding industry
- Develop partners in Asia (Korea and Japan)



Issues

- Used standard DEXlib templates so far
 - May need to develop new templates
 - Template development (2 / day) is slow
 - DEXlib standard templates still evolving
- PLCS updating to edition 2
 - DEXlib templates will change some
- May need changes to PLCS ESPRESS schema
 - Unlikely, but STEP modules moving to updates on quarterly basis



Way Ahead

- Phase I Option
 - Work with shipyards on interfaces to their tools
 - Develop interface to LEAPS
- Phase II
 - Develop working prototype and demonstrate
- Phase III
 - Transition to ship acquisition program
- Commercialization
 - Services and licenses to shipyards



Questions?

Charlie Stirk

CostVision Inc.

303-539-9312

stirk@costvision.com