The F-35 FACO project
Final Assembly and Check Out (FACO)
PLM Interoperability

NATO LCM
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World leaders in Industrial Data Management using ISO standards

- **Data modeling**
  Create your own data models, or use for viewing and documentation (ISO)

- **Database management**
  The ideal tool for data integration and application development projects

- **Rule engine**
  Validate your data sets, using your own business, knowledge rules or any other sets of rules

- **Web services**
  For use in web server applications (thin clients)

**Universal Solutions for Interoperability and Sharing of Product Data**
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Agenda

1. Highlights from the 2012 AIA Product Support Conference
2. Standards Overview
3. Implementation Projects related to F-35
4. Some observations related to project requirements of CM/ILS
ISO TC 184 SC4 – ISO 10303 STEP
The big picture
1. Highlights from the 2012 AIA Product Support Conference

- Government entitled to Unlimited Rights
  - Operation, maintenance, installation, or training (other than detailed manufacturing or process data)
  - Form, fit, or function
  - ...

- Government may also want data
  - for emergency repair and overhaul
  - to support design reviews
  - to support downstream systems
  - to compete spares, support, upgrades, mods, and/or production

SOURCE:
AIA Product Support Conference
November, 2012
For Government

Benefits
- Reduce cost and risks of translation and formatting of acquired data
- Facilitate transition from contractor-managed to Government-managed data
- Reduce costs of managing data by using common processes, tools, and formats

Challenges
- Specify standards on new acquisitions
- Pursue standards on existing programs
- Work with solution providers and industry to accelerate adoption of standards

SOURCE:
AIA Product Support Conference
November, 2012
For Industry

Benefits

• Save money on content creation and maintenance through re-use
• Provide a better solution to customers (e.g., data, integrated data environments)
• Standardized internal tools and processes for configuration management of data

Challenges

• Incorporate standards as part of internal operations
• Work with solution providers and Government to accelerate adoption of standards

SOURCE:
AIA Product Support Conference
November, 2012
Supportability Analysis Effort Introduction

• Services requested re-issue of MIL-STD 1388
• Nov 2011 Defense Standardization Council outbrief concluded:
  • There is no standard approach to identify (contractually require the contractor to provide) the supportability analysis tasks that must be accomplished across the system life cycle to provide affordable and effective product support
  • Policy
    – DODI 5000.02 Volume 2 Encl 8 (DRAFT) requires the Product Support Manager
      “Determine the most effective product support strategy using appropriate analytical tools (e.g., Supportability Analysis, Product Support Business Case Analysis (BCA), Core Logistics Analysis/Source of Repair Analysis). The tools shall incorporate risk analysis, sensitivity analyses, and the cost-benefit analysis concepts contained in Office of Management and Budget Circular A-94”
  • Guidance
    – MIL- HDBK – 502, Acquisition Logistics (requires major revision)
  • Standards
    – ANSI/GEIA 0007, Logistics Product Data Model
    – ISO 10303 Standard for the Exchange of Product Data
    – ASD Sx000x Series, International Specifications
Summary

Aerospace OEMs are seeking a different approach to ILS

- No re keying of data - Nobody wants an army of typists!
- BoM/Product Centric
- Provides ability for physical/functional structures and hybrid structures
- Closes the gap for engineering source data and change management
- Enables selective standards compliance (pick list)
- Enables direct re-use rather than "Re Type"
  - Eng/Manuf BoM to Service Parts (IPD)
  - Service plan to service task (xml data module)
  - Associative to source CAD data – automatic illustration update

- Enables non proprietary data transfer
  - PLCS Dex 1, Dex 3
  - S3000L>S1000D – S1003X
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ASD Organization

Organizational structure - ASD

ASD - PSG
Product Support Group

The ILS-SG
ILS Specifications Group

The ILS Spec Council

The STE Maintenance Group

The SX000I Steering Committee

The $1000D Steering Committee

The $2000M Steering Committee

The $3000L Steering Committee

The $4000M Steering Committee

The $5000F Steering Committee

The Data Model and Exchange Working Group

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ILS-SG Report to SSG

2011-03-08
ASD Suite of standards supported by PLCS

- S9000: ILS Data dictionary
- S3000: LSA/LSAR
- S1000: Tech pubs
- S2000M: Material management
- S4000M: RCM/MSG-3
- S5000F: Operational and maintenance data feedback

PLCS (ILS) repository

Tech pubs → CSDB → Training

Source: EADS - Saab
PLCS capabilities

Change Management
- Work request
- Approval
- Work order

Provide Support
- Operational feedback
- Activity
- Resource as realized
- Planning
- Activity feedback
- Resource management
- Project

Product Data
- Products
- Versions
- Serialized items
- Document
- Breakdown
- Effectivity
- Configuration

Support Engineering
- Personnel
- Organization
- Position
- Qualification
- Resources (Required)
- Condition
- Task
- Location
- Task method/step
- Facilities

Extensions
- State
- Multi linguism
- Risk
- Observations
PLCS – Data Exchange Specifications

● DEXs are: (S3000L= AD DEX 1 and AD DEX 3 from ASD/AIA )
  – Subsets of the AP239 Information model
  – Selected to meet a specific data exchange need
  – Built from relevant modules
  – Supported by usage guidance, capabilities, templates and reference data
  – Can be refined from other DEXs

● DEXs may be standardized at any level (work group, company, project, organization, national, international)

● DEXs enable
  – Consistent implementation of AP239
  – Data consolidation through time
DEX3:
Task Specification Overview

- Templates used to configure DEX3
  
  **Product in Focus;**
  **Task definition;**
  **Task resources;**
  **Task trigger;**
  **Task end item context;**
  **Structured task;**
  **Task effectivity;**
  **Task compound conditions representation;**
  **Task administrative information;**
  **Task message;**
  **Optional characterizations of templates;**
ISO 10303 PDM Modular breakdown

PDM Schema

- Product identification
  - part identification
  - document identification (logical documents, not files)
  - product version
    - part version
    - document version
  - product definition
    - part definition
    - document definition
- File identification (external ref.)

- Product structure
  - part structure
  - document structure

- Product properties
  - part properties
  - document properties

- File properties
  (document properties applied to file references)

- general organisational/management data
- end item identification
  - product concept, configuration item
- effectivity
  - planned configuration
  - general validity period
Eurofighter Typhoon

Structural build work share:
- 37.5% BAE SYSTEMS
- 30% EADS-Germany
- 19.5% ALENIA
- 13% EADS-CASA

Suppliers

Concurrent product development

Common supplier base

Four assembly lines

National and export customers
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Lockheed Martin F-35
Final Assembly and Check out
Connecting 2 PLM systems

F-35 team in Fort Worth, Texas, USA

F-35 final assembly and checkout facility (FACO) is being constructed at Cameri Air Base (Novara, Piedmont).
UID Information data exchange

Type: DOOR ASSY, REFUEL PROBE - FWD
Marking:
CAG 6B023
PNO 2FSH61011-0002
SEQ 00034
Mapping and Modeling

PLM Schema

Reference Model (CDM)

PDM Schema ISO 10303

Mapping

Physical Layer

Conceptual Layer

Interface Layer

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STEP Conversion

1. Import Part 28
2. Convert to ISO/PDM Schema
3. Export Part 21
Lessons Learned

• Avoid Complexity
• Start Simple
• Defer Non-Essentials
• Good reading

“Aerospace Industry Guidelines for Implementing Interoperability Standards for Engineering Data”
AIA Data exchange Handbook

3 Concepts of operation

Companies wishing to adopt standards based data exchanges should follow an overall process similar to figure 3-1.

Figure 3-1, Implementing data exchange based on standards
Input to converter development
What the IT developer produces: Mapping Code

Source Model

Target model

Mapping specification
Software architecture

Correspondence between specification and software layers:

- The CDM2PDM converter either instantiates pdm_schema entities directly or makes use of functions from an API which instantiates more complex structures (like properties, managed documents etc.) Each function in the API corresponds to a virtual template.

- The converted data is stored in a PDM repository which corresponds exactly to the data model of the PDM_SCHEMA.
Debugger tools for mapping code
Quality assurance

7 Perform data exchanges and verify data quality

This section describes the production process of translating source information to the target system and validating the success of the translation process.

Figure 7-1, Outgoing exchange and quality process

Source: AIA Handbook
Quality assurance

Data Preparation
- PDM model data submitted for release

Ingest

Exchange preparation
- Generate STEP file from source, as required
- Read CAD/PDM data in STEP format into EDM repository
  - Parse STEP file
  - Validate/verify according to AP
  - Compare retrieved and generated Validation Properties
  - Validate/verify according to Rec. Practices
  - Validate/verify according to company rules
  - Validate/verify according to EN 9300
  - View data for end-user validation
Quality assurance

Each test consists of a pair of test queries. The first query in such a pair is applicable for the CDM population. The second one is applicable for the PDM population. A test is passed if the two corresponding report files are identical. Sufficient test queries are written in order to verify that the complete population has been accurately converted.
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PLCS Requirements in US DoD projects

Department of Air Force, which relates to “Acquisition and Sustainment Life Cycle Management”, the following requirements are included:


• 3.91.1.2. Legacy system modifications shall implement ISO 10303 for new engineering data to the maximum extent feasible. Conversion to ISO 10303 for the entire legacy system is encouraged when supported by a positive business case analysis (BCA).

• 3.95.1. The PM shall address industrial base constraints in the LCMP. This should address mitigation to ensure that the system(s) can be supported during its life cycle. Open systems design, including Modular Open Systems Approach (MOSA), can help mitigate the risks associated with technology obsolescence and diminishing manufacturing capabilities by avoiding being locked into proprietary technology or by relying on a single source over the life of a system. Incremental development also should be considered to alleviate obsolescence concerns.

4. APPLICABLE DOCUMENTS AND FORMS
From International RFP’s

1. “The format of the communication of the agreed scope of product data shall be according to ISO 10303-239 (named Product Life Cycle Support, PLCS). The product data shall describe a system structure. This system structure should serve as a basis for requirement, functional, product design, support system design and product in-service view of the entire system. For product shape related data ISO 10303-203 or relevant parts of ISO 10303-214 shall be used. The data should consist of both the metadata (the structure) and relevant documents describing the system. A description of the agreed scope, an appendix shall be developed jointly by the Purchaser and the Contractor. This appendix shall be updated continuously during project execution upon mutual agreement. The final specification with the product data information types, based on the refined appendix, and solution for delivery of product data shall be included.”

2. FMV, Sweden, Protected Tracked All-Terrain Vehicles (360881-AI820276 RFQ BvNy System

- Req. P66 "The Tenderer should use the principles of ISO10303 AP239 PLCS to information and data management“
- Req. P79 "The Contractor shall deliver LSA data in the form of an LSAR compatible with ISO10303 AP 239 PLCS."
• Jotne and Lockheed Martin Aeronautics will conduct a seminar, on the subject of “Global Integration and Management of 21st Century Fighters.” The seminar will help companies comply with the ISO standards for data exchange and sharing of engineering and logistics support data.