AP239 Product Life Cycle Support
Managing Product Support Information from Concept to Disposal

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PLCS Awareness Seminar,
Warwick, 19 November 2003
**Topics:** PLCS scope and key features

1. Who am I?
2. What business problem are we solving?
3. The PLCS process and deliverables
   - Activity Model
   - Information Model
4. Delivering the payoff
   - STEP costs and benefits
   - Implementing PLCS
5. Concluding Remarks
1. Personal background

- **1966 - 1996 with UK MoD**
  - 20 years Engineering Program Management (mainly Ships and Submarines)
  - 10 years IT and Change Management
- **1996 - 1999 Director, NATO CALS Office, Brussels.**
- **Chair of “Product Life Cycle” team for STEP (ISO/TC184/SC4 WG3/T8)**
- “Retired” from UK MoD Oct 1999
  - Joined Eurostep Limited
- **1999-2003 Program Manager PLCS, Inc**
2. The critical question from NATO CALS:

What business problem are we solving?
2. The PLCS answer:

How do you keep the information needed to maintain a complex product, in line with the changing product over its full life cycle?
2. What information is involved?

- Product requirements
- Product design, including variants/options
- The FMECA results
- Support environment and resource descriptions
- Maintenance Plans and provisioning recommendations
- Justification for above (e.g. LSAR)
- Technical Documentation and IPC
- Product Manufacture and QA records
- Work Plans
- Configuration records
- Product Usage, Fault & Defect reports
- F700 forms (work done)

This INFORMATION is a critical ASSET and needs to be managed as such!
2. Effective management of this information set enables:

- **Contracting for availability or capability**
  - clarity in support performance requirements
  - capture of the feedback required for payment metrics
  - continuous support improvement, (not just a “one off” LSAR)
  - removal of “stovepipes” from current support data standards
  - framework for long term data retention

- **SMART acquisition by enabling continuous, rapid change** (e.g. technology insertion)

- **Progressive integration across existing IT systems:** Requirements, CAD, PDM, ERP, MRP and other logistic systems

*PLCS has tackled an important business problem at exactly the right time*
3. PLCS Development Process

Data Exchange Sets

~34 (DEX)
- Business Process
- Usage Guide
- DEX Reference Data
- Local Constraints

Map to AAM Arrows

~1700 Data Model Requirements

133 STEP Modules

Other Sources

Arrow Content

Info Model

AP

DEX ..N
DEX 3
DEX 2
DEX 1

Application Module
Data Exchange Set (DEX)
3. PLCS Deliverables – The Activity Model (AAM)

A comprehensive, well documented, hierarchical process model which shows the:

- activities (boxes)
- and information flows (arrows)

...needed to deliver the PLCS vision
3. Product Life Cycle Support (PLCS)

The Vision

Scope of STEP Today

- Product Structure
- Product Representations
- Product Performance
- Support Performance
- Support Environment
- Failure Analysis
- Maintenance Analysis
- Task Resource Data

Change Directives

Life Cycle Data

- Standard Commercial Transactions
  - Feed and Extract
  - Query

Maintain/Dispose

Use

Derived Disposable Data

Support and Operational Feedback

Respond
3. AAM Background

- Developed over the period 1999 to 2003 by the PLCS sponsors
- More than 2000 man days of effort from international subject experts, plus sponsor and ISO reviews
- Freely available in many formats – Word, PowerPoint, html, XML and IDEF 0 (.bpwin or .idl) – (www.plcsinc.org)
- Will be published as Annex F to AP239 (DIS) with informative status

- Being used by MoD, BAES, NoDLO and others to explore relevant interfaces, and update business processes.
3. AAM Purpose

Purpose of the activity model changed with time:

- Initially: to clarify the scope and meaning of “product life cycle support”
- Then: used to establish the information requirements for AP239 by analysis of arrows (and other inputs)

The AAM now provides:

- Illustration of the activities and information flows supported by Application Protocol 239
- the business users “entry point” to the information standard
- a context for the Data Exchange sets (DEX)
- a best practice benchmark for product life cycle support processes
3. AAM Context Diagram

**Purpose:** To represent the activities and information flows supported by Application Protocol 239 Product Life Cycle Support (PLCS). The set of products to be supported is known as the "product in focus" or PIF.

**Viewpoint:** The life-cycle owner who acquires the product-in-focus and strives to maximise value over the complete life cycle of the product, by taking whatever actions are necessary to deliver the required operational capability at minimum life cycle cost.

**Note 1:** Dashed (---) arrows represent physical items (blue where diagrams are reproduced in colour). All other arrows represent information.

**Note 2:** All tunnelled arrows in this model apply to all decompositions of the applicable box.

**Note 3:** APSI = assured product & support information
Provide through life support for product

1. Manage information to support a product
   - Manage configuration change
   - Manage identification
   - Manage information

2. Generate support solutions
   - Manage support engineering programme
   - Define support context
   - Establish requirements for support solution
   - Design support solution
   - Assess support performance

3. Commission support system
   - Develop commissioning schedule
   - Analyze commissioning data
   - Certify support system

4. Provide support
   - Plan & control support delivery
   - Arrange support element provision
   - Execute authorized task
   - Collect data & provide feedback
3. PLCS activities – what changes?

- Commit to a single source of Assured Product and Support Information (APSI)
- “Tech docs” become “views on the APSI”
- LSA becomes a continuous process, driven by support performance requirements, linked to payment metrics in contracts
- Feedback requirements are derived from the required metrics. Required feedback can be defined in task descriptions.
- Work planning and feedback capture can be substantially automated
- The processes for:
  - Configuration management
  - Product data management
  - Support data management

.....MERGE
3. AP239 Information Model (the normative standard)

- **Current Standards:**
  - Encourage stovepipes of information (Relational, SGML, EDI, Paper)
  - Predate the internet age
- **Need a new standard to apply modern information management principles:**
  - Acquire once - use many times
  - Share
    - over distance
    - over time
  - Separate “Information” from “Format”
  - Use consistent terminology
  - Capture sufficient context to give “Clean Water” data, especially for feedback
- **This requires a common Conceptual Data Model to share and exchange product support information through life …
- … an extension to ISO 10303 (STEP).**
3. PLCS: Inputs to AP239

- EXPRESS based
- Relational
- Mil Spec 1388
- FMV CTG2
- AP203
- STEP
- AECMA 1000D 2000M
- AP208
- IDEF1-X
- PLCS Initiative
- MIL Spec 2549
- POSC/Caesar
- Logical
- Def Stan 00-60
- RCM IT
- F700 forms
- Def Stan 00-60 Logical
- PLCS
- AP 239 PLCS
- NCDM
- ATA Effectivity
- PDM Schema
- AP 233
- OMG
- ISO 15288
- EIA 649
- AECMA 1000D 2000M
- SGML EDIFACT
- AP 203
- Def Stan 00-57
3. AP239 Development Principles

- Create a durable data model standard that can be extended or tailored over time
  - Identify key generic concepts and relationships
  - Extend/tailor by classification and ref data libraries
- Build on the 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
  - Activity, State, Product Structure
- Encourage move towards a “single source” of Assured Product and Support Information (APSI)
  - Improve accuracy
  - Reduce duplication
  - Improve Configuration Management

Aim: to enable optimisation of support through life
3. AP239 is a Modular STEP Application Protocol

- Extensive re-use of STEP PDM modules
  - To bring compatibility with design/PDM tools
  - Basic work order/work request process common to change in design
- Extended to provide
  - Life cycle CM
  - Full work management capability
  - Condition based task triggers
- Harmonization with other STEP projects achieved where needed by using common modules
  - With CAD/PDM via PDM Modules and AP236 (214 based)
  - With Requirement Tools via AP233
- Comprises:
  - 133 STEP modules, in a hierarchy leading to a single root (the “AP module”)
  - A supporting AP document
3. Implementation module: ap239_part_definition_information

- product_as_individual
- interface
- interface_lifecycle
- State_definition
- State_observed
- ap239_management_resource_information
- product_management_data
- ap239_document_management
- ap239_properties
- requirement_management
3. Implementation module: 
ap239_product_definition_information

- ap239_product_definition_information
  - assembly_structure
  - part_definition_relationship
  - product_replacement
  - product_view_definition_relationship
  - product_relationship
  - product_breakdown
    - system_breakdown
    - zonal_breakdown
    - hybrid_breakdown
    - functional_breakdown
    - physical_breakdown
  - attachment_slot
  - ap239_part_definition_information
3. What is “a Module”

- An ISO document defining a standard information model
- Contents:
  - Introduction
  - Scope
  - Normative references
  - Terms, definitions and abbreviations
  - Information Requirement model (ARM)
  - Module Interpreted model (MIM)
- Information model is defined in EXPRESS in three ways:
  - Lexical – words for humans – sometimes with notes and examples
  - Graphical – pictures for humans
  - Computer listing – EXPRESS code for implementation – translatable into many languages, including XML
3. Graphical view of a simple module
ISO 10303-1047 Activity
A standardised information model,
defining
the meaning and the structure of the information
needed
to meet optimise support delivery
over
the full product life
PLCS costs

- Initial ideas from 1990
- 3 years preparatory work in/by NATO CALS Office
- 4 years as an active project via PLCS, Inc.:
  - 17 sponsors
  - ~ $2 Million cash budget
  - ~ 10,000 man days of contributed effort, from ~70 active participants
  - ~ 150 meetings with international travel
- Total cost = < $10 Million
- So how do we get a Return on Investment?
4. Delivering the payoff

- **STEP costs and benefits**
  - Implementation Process
  - NIST Report
  - SPANS

- **Implementing PLCS**
  - DEXs
  - APSI pilots

- **Concluding Remarks**
**STEP Implementation Process**

**Requirements Definition**
- Provides feedback on concept
- Captures industry requirements

**Prototype/Proof-Of-Concept**
- Clarifies vision and validates usage scenario
- Implements and validates model

**Pilot Project**
- Develops and tests software in Implementer's Forum
- Identifies necessary process changes to maximize benefits

**Production**
- Produces commercial products and services
- Puts system in production use, resulting in increased affordability
- New users and vendors benefit from the system in various applications

**Legend**
- Implementors/Vendors
- Users

**DEXs and Pilots**

**AP239 (99-03)**
STEP saves BIG money

NIST Planning Report 05-02, December
“Economic Impact Assessment of the International Standard for the Exchange of Product Model Data (STEP) in (US) Transportation Equipment Industries”

- **STEP investment cost, 1985-2001** = $100M
- **STEP benefits to date** = $1.1BN
- **Current savings now** $156M per annum
- **Based on 17% take up**
Mission:

Improve Affordability of Navy Acquisition Programs by Increasing the Efficiency of the Supporting Supply Chain Networks

Success Metric:

The SPANS program measure of success will be the deployment of changes in supply chain processes/technologies within one or more Navy weapon system procurement programs

(see http://pdesinc.aticorp.org/downloadable_files/AFEI_DennySimon.pdf)
SPANS elements

- SPANS has five elements, each being tested on a different program:
  - STEP for Affordable Manufacture (STAMP)
  - Supply Chain Value Stream Management (SC-VSM)
  - Supply Chain Dynamics (SC-D)
  - Construction History and Parametrics (CHAPS)
  - Technology Refreshment for Navy Transformation (TRENT)

- All SPANS project involve process and information models
- Three programs in black use STEP directly
- SPANS is jointly funded by DoD and Industry
Raytheon currently delivers Technical Data Packages (TDPs) in paper form

- 2 weeks to prepare and deliver a TDP to suppliers
- Suppliers receive large package of paper data, referenced only by a single paper supplier information sheet (SIS)
- SIS managed by hand at Raytheon

Labor and cycle time intensive for both Raytheon and its suppliers

Not unique to Raytheon: common in other Navy projects
STAMP – estimated benefits

One Missile Program

- Labour savings at Prime of 25 hours per TDP (50%):
  - 20 TDP/month x 12 months x 25 hours/TDP x $100/hour = $600K
- Labour savings at Supplier 6 hours per TDP:
  - 20 TDP/month x 12 months x 6 hours/TDP x $90/hour = $130K
- Cycle time greater than 80%:
  - From 2 Weeks to 3 Days

Estimate savings across Raytheon = $9M-$16M per annum

(LMCO Forth Worth have already implemented a similar capability)
Tactical exploitation by programs – use what fits

- Activity model
- Interface pilots
- Single source data (APSI) pilots

Strategic work by Defence organizations and industry partners:

- Ongoing standardization:
  - DIS to IS (and beyond?)
  - DEXs
  - Mappings to current standards
- Policy Updates
- Updates of related standards and ILS training
DEXs now in development

- product_breakdown_for_support (No Navy/LSC/PTC)
- fault_states (RR/UK MoD/Eurostep)
- operational_feedback (  "     "       "        "       )
- maintenance_plan (FMV Sweden/Aerotech)
- work_package_definition (MoD/DML/LSC)
- work_package_report (   "     "       "     )
Concluding remarks

- **PLCS is an essential enabler to both SMART Acquisition & Performance Based Logistics**

- **Experience from the rest of STEP shows:**
  - AP publication is only the first stage in the process
  - Implementation needs investment and is hard work
  - Large benefits are available, to those who make the effort

- **AP239, as part of STEP, is likely to shape the product support information scene for the next 30 years (as 1388 did beforehand)**

- **It has been a great privilege to be involved**

- **You should try it!**
PLCS: relationship to other standards - Summary

- **Looking back**
  - AP239 acknowledges a debt to all listed inputs

- **Current position**
  - AP239 can use the data generated by current ILS standards
  - AP239 implementers will need to cleanse and enhance the data generated by current standards (its not very good!)
  - AP239 enables, but does not force, much higher levels of data integration

- **The future**
  - AP239, and other factors, will drive change in most current ILS standards (e.g. DEF STAN 00-60)
  - The pace and direction of this change depends on market factors