Using ISO 10303, Express, the information Modeling language, to create advanced Solutions for Industrial Data Applications.

Overview of World-wide Projects

Kjell A. Bengtsson  
EPM Technology  
Kjell.Bengtsson@epmtech.jotne.com  
http://www.epmtech.jotne.com
Universal Solutions for Interoperability.
Data modeling, exchange, sharing, ODBMS.
EXPRESS Data Manager™, world-wide.
Topics

- Need for data exchange and sharing
- What has been achieved
- Technology available

Σ: Use models with rich semantics to improve global interoperability
Need for data exchange and sharing

Types of Integrations

- **Encapsulation**
  - Systems recognizes application files and can launch the application

- **Interface**
  - Systems and the application can exchange files and some meta-data automatically (without user intervention), System functions are provided via the application’s menus (or vice-versa). Data is not 2-way associative,

- **Integration**
  - Provides full, automatic exchange of all types of product data and meta-data, application-specific data (such as product structures) are 2-way associative and managed by the system, all system functions are available in the application (or vice-versa), the user works in a consistent environment
Complex systems requires intelligent solutions
Organizations that care about your problems!
MDA (Express based standards)

Many standards are now ready for use - it is time to deploy them.
The EXPRESS language

An Information modeling language defined by ISO TC184/SC4 and published as ISO 10303-11

Now being released as Edition 2

- Open and public available data models
- Free objects for engineers and used for Industrial applications
- Find your domain specifics e.g. Aerospace, Automotive, Building, Defence etc.
An abstraction of the real world

**Real World**

Name of person

Address
- Street
- City

Telephone number

**Abstraction**

ENTITY PERSON;
  name : STRING;
  lives_in : Address;
  owns : Telephone;
END_ENTITY;

ENTITY Telephone;
  no : INTEGER;
END_ENTITY;

ENTITY Address;
  street : STRING;
  city : STRING;
END_ENTITY;
EXPRESS is an Information modelling language. It consists of language elements that allow an unambiguous data definition and the specification of constraints on those defined data.

- All you need: SCHEMA, TYPE, ENTITY, RULE, FUNCTION, PROCEDURE, CONSTANT etc

- Readable to humans and fully computer interpretable

- Textual and graphical notation.

- Supported with C, C++, Java, VB, XML, .NET platforms
The EXPRESS language

- Published as ISO 10303-11 and used for most product data standards such as: ISO 10303 (STEP&PLCS), ISO 13584 (PLIB), ISO 15331 (MANDATE), ISO 15926 (OIL&GAS), IFC, EDIF, IEC 6610, IEEE standards etc.

- The standards uses EXPRESS to define requirements, documented as data models and ready-to-use objects. Free to download

- Express-X (ISO 10303-14) used for migration of legacy data models

- ISO 10303-21 and -28 supports text and XML data exchange
MDA Implementation workflow

Design requirements
System requirements

Data modeling

Extra constraints

Rule Schema
Engineering knowledge, Persistent EXPRESS objects

Documentation
Web reports, ISO documents, Text documents

Application support

EXPRESS Object Database
High performance Persistent EXPRESS objects

Query/View

Rule Engine
Validation results

Mapping EXPRESS-X
Translation

Validation of data results

C
C++, C#, .NET
Java, JSP
VB, XML
Webserver
Apache, IIS

SDAI
• Express-G for data modeling

• Express SDK have to include support for
  • XML, C, C++, HTML, JAVA, VB, Soap, .net etc
  • Query definitions for business objects

• Express-X, used for mapping between databases

• Business, Engineering and knowledge rules

• ProductModelServer, Web server for PDM/CAD/PLCS
  includes support for repositories and databases
  supporting any XML requests.
Model Migration

Model Analysis Tool..

- Legacy data analysis and mapping
- Identifying gaps in data models
- Create the specification for mapping and implementation
What value ISO 10303?

“STEP has the potential to save $928 million (2001$) per year by reducing interoperability problems in the automotive, aerospace, and shipbuilding industries alone.”
MEMORANDUM FOR THE AIR FORCE ACQUISITION EXECUTIVE
NAVY ACQUISITION EXECUTIVE
ARMY ACQUISITION EXECUTIVE

SUBJECT: Strategy for Product Data throughout the Life Cycle

1. Last year, we evaluated the benefits of standardizing on common product data exchange requirements. In particular, we were interested in standards that would allow engineering data developed under one automated design tool to be read and manipulated by design teams using different automated tools. We determined the existing ISO 10303 (Standard for Exchange of Product model data – STEP) met our military aeronautical requirements and that it was widely used by the commercial aerospace community. As a result, we have approved the use of STEP throughout our commands. Since STEP is a standard with many applications beyond aerospace (e.g., it is required in Navy shipbuilding), we encourage you to consider its use in other sectors.

2. Our implementation approach will be to use STEP in new aerospace system designs and major modifications to existing systems unless either the cognizant PEO or Systems Commander approves a waiver. The services have agreed and hence its use should be considered mandatory. Where a business case supports this, we are also encouraging the use of STEP for legacy systems.

3. The use of STEP will give us the greatest flexibility to take advantage of new computer design and support tools, but the real benefit to our services will be seen in reduced cost and cycle time, and improved interoperability. I would be pleased to arrange a briefing on STEP and our intended implementation, if you would like.

4. My point of contact for this subject is Mr. James Arnold, ASC/ENSM, DSN 785-9883, email: James.Arnold2.wpafb.af.mil

RICHARD V. REYNOLDS
Lieutenant General, USAF

2 May 2002

MEMORANDUM FOR THE AIR FORCE ACQUISITION EXECUTIVE
NAVY ACQUISITION EXECUTIVE
ARMY ACQUISITION EXECUTIVE
Joint Technical Architecture mandates ISO 10303.

See pages 115 through 117 for references to the mandated use of ISO 10303 STEP.

ISO 10303 will enable UK MOD to contract against an Open, Neutral and Commercial ISO Support Data Standard

ISO 10303 is a keystone in the development of the MOD support transformation policy and driving down equipment support costs.
NDLO Policy Statement

NDLO believe that PLCS will become the leading standard for Product Data and Life Cycle Management.

*I’m convinced that this work will lead to;
Seamless transaction of product data;
Higher availability on our assets; and as a consequence
Lower costs in operation.*

Commodore Morten Jacobsen
Chief of NDLO/Material Investment
the PLCS Nordic launch
Stockholm 9th September 2003
Early demonstration of PLCS
UK MoD Video

The first “STEP” towards delivering the PLCS vision

Keeping support information aligned with a changing product over the entire life cycle
ISO 10303-239 The International Standard for Product Life Cycle Support

- All product and logistics data in one unified repository.
- Complete product life cycle - from concept to disposal
- Single source of assured product and support information
- Data Independence, Freedom of choice for processes, software applications and data format
- Integrated suite of data models
- Facilitating data exchange and information sharing
- Extensibility through the use of Reference Data libraries
Companies implementing STEP report up to 40% reduction in product development time, and up to 30% cost savings attributable to improved process and data management.

STEP enables re-use of design and manufacturing information for complex products such as aircraft, automobiles, and ships over the full product life, 10-20 years and more.

Raytheon projected a $9M-$16M annual labor savings in-house, and approximately $2M for it’s suppliers if it implemented its STEP TDP process across all it’s missile programs.
Need for data exchange and sharing

Data exchange cost saving view

50% process savings for exchange of complex composite parts to Material property systems (MPS/ERP)

27% projected savings for design systems (CAD)

38% projected savings for manufacturing systems (CAM NC)

Process savings

“Technologies play an important role in BAE SYSTEMS main objective of 100% programme adherence, 50% reduction in design life-cycle time and 30% reduction in design cost.

Contractual

“STEP is identified as The Boeing Company Standard for product data exchange. Boeing will only consider purchase of products that comply with STEP. It is Boeing’s intent that our partners and suppliers comply with STEP as a requirement for maintaining business with Boeing.”

Ready to use data model for PDM systems part of the AP214 application protocol.

Supported by http://www.pdm-if.org/ where most PDM/ERP vendors are members.

Stop defining your own objects, save time and cost by re-use.

Browse the model at: http://www.pdm-if.org
What has been achieved?

• Deployed in production on Eurofighter
• Currently being used for exchange of configuration management and build standard data
• Savings resulting from:
  – Elimination of manual BoM extraction
  – Elimination of manual model extraction
  – Reduced change requests
  – Improved data quality

(source BAE Systems)
What has been achieved?

Deployed at Airbus
Information Quality Management
- Validation of PDM/PLM Data

VIVACE - COMPASS
Common Aircraft Multidisciplinary Integration
Backbone for Structure Engineering Simulations

PRODEFA, a PLM project and with an PLCS centric
effort.
Data Exchange

VPM (DMU Navigator)  

EPD Connect (dVise)
PLCS Member, UK based LSC, using EXPRESS based web server:

"In a demanding six-week timescale, the project team delivered an environment to demonstrate the potential for PLCS to deliver real business benefits, even at this early stage in the development programme."
PLCS - Product Life Cycle Support

Largest known PLCS implementation project in the world, Norwegian Frigates, part of the € 2 billion program delivered by Spanish Shipyard Izar, and the Lockheed Martin NE&SS Weapon Systems.

- Enterprise and mission integration
- Joint Technical Architecture
- Unified Object Definitions
- Improved availability
- Improved quality
- Reduced cost
Automotive industry is using STEP-CAD and PDM data for a number of years

Example: PDM data exchange between Windchill® and EnoviaVPM at Webasto

[Image of a car and a 3D model]
ESA Real Life Data

ESA METOP
Earth Observation Satellite

EXPRESS Data Manager as a STEP Database

Data model
Product structure in XML
3D Design
STEP file
Analysis Result
Universal Web access

EADS
Jotne
EPM Technology
IAI standards (IFC’s) for the building sector

Engineering Portal

Rule & Knowledge Engine

CAD & PDM translation engine

Government Portal incl. Approvals

Supplier Portal

e-Catalogue Portal
Building Model
Architectural Design
- Data management
- 3D presentation,
- Coordination,
- Product data
- Drawing output

Structural
HVAC
Electrical
Piped Services / Fire
Elevator / transportation
Specification Estimating
Other…

Building Server

IFC
RULE ENGINE
Singapore

Select object(s) building model

Attach RULE Schema(s)

Report file HTML, XML, TXT
Real Life Data: Largest Building project in Norway
BARBi - The Norwegian Building Industry's Reference Data Library

Give precise and exact definitions of objects, properties, and relationships - in different languages e.g. Taxonomy Server

Implementing ISO 12006
Using Express Object Database, Java, Java Servlets
ISO 15926 - Oil & Gas incl. Process

Supported by most Oil & Gas Companies and their engineering contractors.
IEEE 1232 and 1522 Standards - Test And Diagnosis

IEEE Std 1232-1995. IEEE Standard for Artificial Intelligence Exchange and Service Tie to All Test Environments (AI-ESTATE)

Dynamic Context Model
Captures state of diagnostic reasoning. Compatible with all of the inference models defined within AI-ESTATE. Instantiated during a diagnostic session. Can be saved to provide historical trace of diagnostic process. Developed in ISO 10303 Part 11 (EXPRESS).

Communications Backbone

Diagnostic Reasoner  Test System  DBMS  System Under Test  Application Executive

http://grouper.ieee.org/groups/1232
http://www.arinc.com

Dr. John Sheppard, ARINC
jsheppar@arinc.com

EPM Technology
Current / planned projects
UK, NO, IT MoD, WEAG project: SIMBASE

Primary scope of SIMBASE project

- Systems engineering toolset
- Synthetic environments toolset
- Logistic engineering toolset
- IMBASE interoperability database that supports the entire life cycle for advanced defence systems
- Design & production toolset

Specification traceability
Requirements & predictions
Support specification
Design specification

Requirements
Results
Specifications

Requirements for information interoperability through querying, sharing & exchange

Jotne EPM Technology
Current project, US NAVY
Immune Building Toolkit Components

Toolkit Database
- Input
  - FC Meteorology
  - Terrain/Elevation
  - Output
  -haft Reports
- Libraries

Case Content
- Building Definition
- Structure
- Protective Measures
- Surface Properties
- Release Scenario
  - Gent
- Delivery System

Grid
(Inernal)

Case Simulation
(Internal Zonal Model)

Post Processing

Simulation Results

Current project, US NAVY Immun Building Toolkit Components

http://www.epmtech.jotne.com

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Current / planned projects, UK - mBomb

Knowledge databases
- Best practise knowledge
- Own practice

Laws and regulations
- Building regulations
- Building specifications

Briefing
- Functional req.
- Estimates
- Conditions
- Requirements

Demolition, refurbishment
- Rebuild
- Demolition
- Restoration

Facility management
- Letting, sale, operations
- Maintenance
- Guaranties

Construction management
- Scheduling
- Logistics, 4D

CAD software
- Drawings, calculations
- VRML
- Visualisation, 3D models

Simulations
- Comfort
- Ventilation, heating
- Life cycle cost
- Light, sound
- Insulation
- Fire, usage
- Environment
- Life time predictions

Specifications
- Specification sheets
- Classification standards
- Estimates, accounting

Procurement
- Product databases
- Price databases

Illustrations: Norwegian Building projects Institute, Olof Granlund, NBLN University of California, Stanford University
Current / planned projects

Validation of large datasets

GRID computing

Parallel computing

inteliGrid
EU program

UNIVERSITY OF OSLO

Jotne  EPM Technology
The Expressway for the future

Increased interoperability through semantic models, based on ISO standards.