

Upper Ontology for AIA/ASD S3000L

Implementation on the basis of
ISO 15926-12

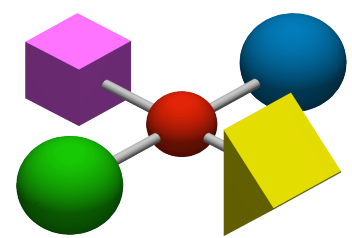
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in cooperation with

Nexter Systems, France



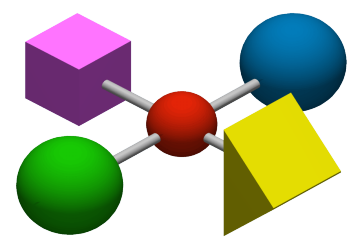
Presented at the
ISO 15926-12 ballot resolution workshop
2016-11-21&22



Background: EBMR

“Armoured Multi-roles vehicles”

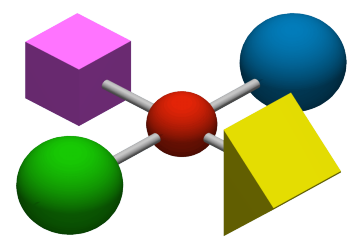
- EBMR is a project of the French army and being implemented by a consortium of French companies:
 - **Nexter Systems**
<http://www.nexter-group.fr/en/press/684-article-du-0512-fr>
 - **Renault Trucks Defense**
<http://www.renault-trucks-defense-group.com/News/Actualites/2014/Attribution-du-marche-EBMR-Scorpion>
 - **Thales**
<https://www.thalesgroup.com/en/worldwide/defence/press-release/scorpion-multi-role-armoured-vehicle-contract-awarded-nexter-rtd-and>
- French army requires to have the Logistic Support Analysis (LSA) information structured along the AIA/ASD S3000L standard and be delivered in PLCS form.
- Nexter Systems is responsible for the needed data integration of the LSA data within the EBMR project.



ALOES

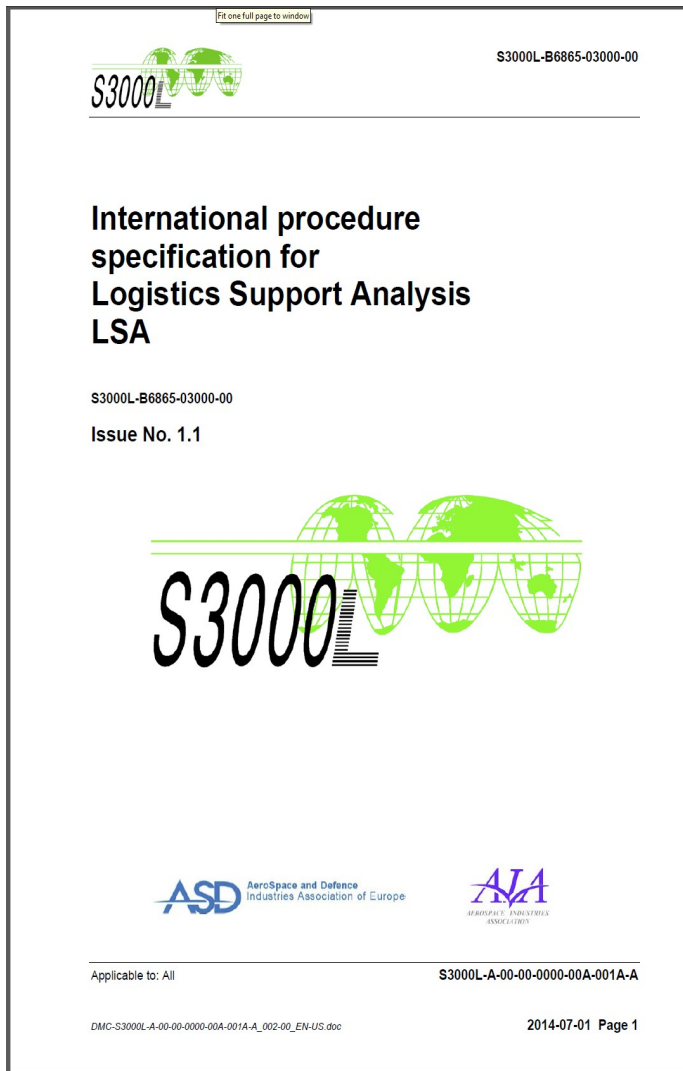
“Advanced Logistic Embedded System”

- a multi user LSA system & editor with a central DB
- implemented on top of JSDAI and JSDAI-DB
- the underlying Express data model is derived from the “NATO Product Data Model”, NPDM, 2000.
- NPDM is a derivate of AP203(214) and a predecessor of PLCS
- the ALOES model is extended to support the MIL-STD 1388-2B format and S3000L concepts
- implemented and maintained by LKSoft exclusively for Nexter Systems
- many years in productive use



AIA/ASD S3000L

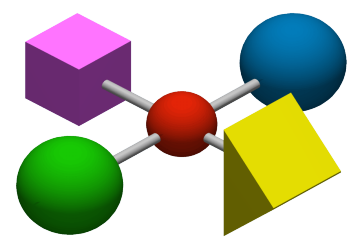
International procedure specification for Logistic Support Analysis (LSA)



The AIA/ASD S3000L is a joint transatlantic specification development, where European and American industrial, aerospace and defence manufacturers and customers participate. The goal is to establish a global specification describing the LSA process, which is one of the most important processes to realize the requirements of Integrated Logistic Support (ILS).

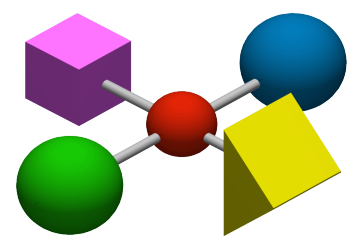
S3000L defines general requirements for Integrated Product Support, configuration management, the analysis activities and the data model for information exchange governing the performance of LSA during the life cycle of any (complex) technical system.

These systems are usually long living and need maintenance during their lifetime. Typical examples are industrial, aerospace and defence products.



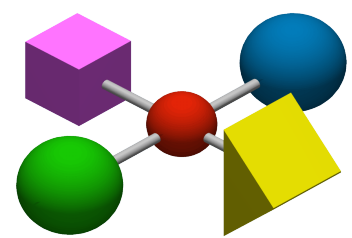
About S3000L

- defined in UML with some 250 classes, 300 data elements (properties) and 130 relations
- developed in the time frame 2006 till 2010 (issue 1.0) and 2014 (issue 1.1)
- replacement of MIL-STD-1388-2B
- intended to be implemented by:
 - PLCS (ISO 10303-239 / OASIS)
 - S3000L XML Schemas (XSD), published end 2015 (no known implementation till spring 2016)



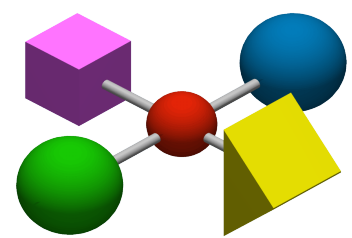
Problems implementing S3000L on the basis of PLCS

- As of today there exist no formal mapping between S3000L and PLCS. The concepts are similar but different.
 - e.g. the breakdown structure is significantly different
 - S3000L is much more detailed than PLCS.
 - need a PLCS reference library for the S3000L specific concepts
- It is unclear what exactly to implement for PLCS:
 - p21 of ISO 10303-239:2012 (edition 2) on the normative MIM level ?
 - p21 or XML for the older OASIS DEXs, based on the AP239 ARM?
 - p21 of the actual PLCS_PSM schema?
 - XML of the actual PLCS_PSM XSD?
 - XML for future AP239 ed3 who's data model / XSD schema is synchronized with STEP-AP242 ed2; using the so called "new architecture"?
- PLCS implementations are inefficient; require many intermediate objects
- Team decided to not use PLCS as an integration platform but to generate it only at the end when customer decides what he exactly expects.



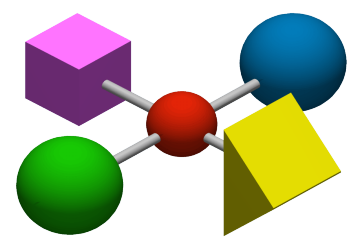
Implemented Solution: Baobab+

- Baobab is a long standing tool developed by Nexter Systems to manage and integrate data in MIL-STD 1388-2B format.
- The new Baobab+ is an extension of Baobab for S3000L
- Nexter Systems and LKSoft agreed to implement the extension in Baobab+ as a web based data integration solution for S3000L using Semantic Web technology.
- An upper S3000L ontology in OWL2 has been defined that is the basis for the internal data storage
- An XML import & export capability based on the S3000L xsd schema had been implemented. This is to our knowledge the first implementation of that schema.
- ALOES is extended to import & export S3000L data based on the upper S3000L ontology.
- EBMR is only the first project for the new technology. Other projects to follow. Also the scope is expected to be extended beyond S3000L in future.



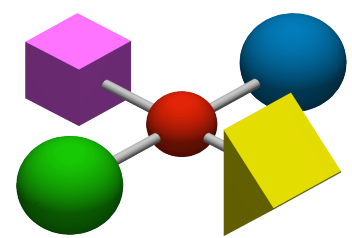
Upper S3000L Ontology

- The S3000L upper ontology is defined in OWL2 and captures all concepts defined in the S3000L standard and some additional details defined in the S3000L xsd schema
- The S3000L ontology was originally directly based on ISO 15926-12, but because of some problems the needed ISO 15926-12 concepts had been copied and adopted only (instead of referencing full ISO 15926-12 ontology).
- A main reason to use SemanticWeb technology is that it allows a much more efficient merging of data coming from different providers.
- use TTL for better readability for both, upper and lower ontology (application data)



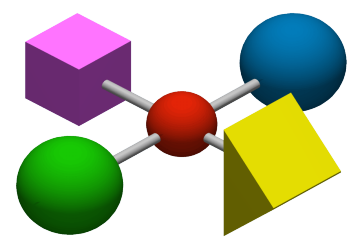
Upper S3000L Ontology strategy

- modify S3000L data model in a few key areas, i.e.
 - introduce ProductOccurrence (like in AP214/242)
 - re-structure some relation classes (sterotypes) and use properties instead
- convert all S3000L UML classes and properties into corresponding OWL classes and properties
- make the new OWL classes sub-classes of ISO 15926-12 classes
make the new OWL properties sub-properties of ISO 15926-12 properties
- define & use properties only in one direction;
e.g. “partOf” instead of “hasPart”
- heavily rely on punning of object and datatype properties, even in application data (lower ontology).
- require application data to be complete and consistent
- don't rely on any formal reasoning. Needed reasoning is done by SPARQL queries only.



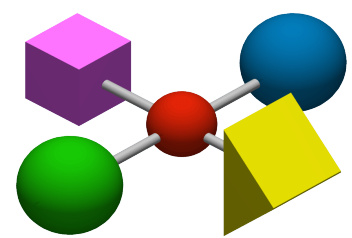
Upper S3000L Ontology

- Encountered problems:
 - DIS version of ISO 15926-12 was delayed, not available for the implementation of Baobab+
 - till today no agreement on “TypicalIndividual” MAJOR ISSUE
 - inference problems with ISO/CD2 15926-12 ontology
- Advantages
 - only a single modelling level
 - very compact, no superfluous data needs to be taken care for applications
 - easy readable (TTL format)



Upper S3000L Ontology

- Disadvantages
 - OWL2 is not a data modelling language; some needed constraints can not be represented in a proper way. => RIF (Rule Interchange Format) from W3C might be a solution
 - no standardized graphical representation, especially for punning
- Current status:
 - version 1.0 is released and in use by ALOES and Babobab+
 - ISO 15926-12 is not imported, instead needed concepts are copied into the S3000L ontology
 - S3000L classes and properties are only partially integrated with ISO 15926-12 concepts



Next Steps:

- Nexter Systems and LKSoft intend to submit the S3000L ontology to the standardization organizations ISO 184/SC4 and AIA/ASD for considering it to make it an international standard.
- In parallel the upper S3000L ontology will become public available under the Creative Commons license "CC BY 4.0".
- Nexter Systems is the licensor of this work.