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A NEW APPROACH TO CREATING AND MANAGING TECHNICAL PUBLICATIONS FOR AIRCRAFT LASTA USING S1000D STANDARD

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Abstract: *Modern technical publications of complex products and equipment from aerospace and defense industry (and beyond) set wide variety of demands and conditions that need to be fulfilled for their efficient, economical and safe use. Increasing complexity of products demand increasing complexity of documentation supporting those products. For stated reasons, modern technical publications are developed as only one, but very significant part of the entire system of Integrated Logistic Support (ILS) of a certain product.*

Keywords: *Technical publications, standardization, S1000D.*

1. INTRODUCTION

Technical publication must provide to its users the ability to get fully acquainted with complex product structure. It also needs to provide precise information about rules of operation and usage in sufficient depth and scope which is necessary for adequate handling, maintenance and monitoring of key characteristics and parameters of complex product in operational service.

Rapid development of Information technologies enabled both production and utilization of such technical documentation (TD) systems that switched from old paper form to new computer data bases. That provided numerous improvements and new possibilities in the whole process. The new approach in design and usage of TD is that focus is set on providing specific piece of information that is required by the user at that moment, rather than going through extensive paper documentation and finding the same information.

2. INTEGRATED LOGISTIC SUPPORT

Integrated Logistic Support (ILS) is development of such technical/information environment that will serve as support to certain product throughout its entire intended life cycle. ILS represents the connection between process of design/development of the product, and process of service use of the same product.

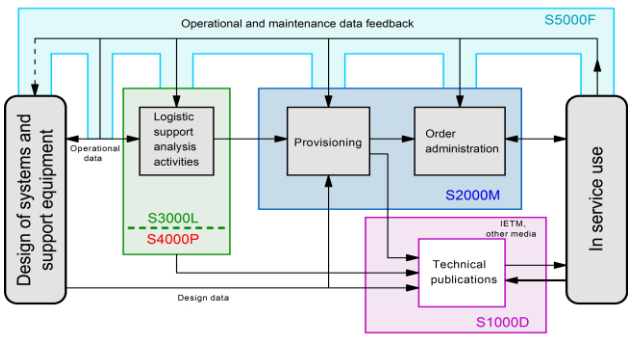
ILS System is intended to provide complete insight into all relevant resources of a product. Applying Logistic Support Analysis (LSA) as part of ILS, it is possible to obtain optimized product that will cost less to develop and produce, and that will have longer service life and more effective maintenance.

Initiative for development of ILS systems was originated in early 80s of the 20th century from the need to coordinate larger number of aerospace and defense industries from different countries that worked on joint projects. It was necessary to define unified system of standards and specifications among all participants.

Main idea was to provide that supportability of a certain product can be analyzed in earliest possible phase of design and development process.

ILS is based on feedback relation that provides early detection of and solution to problems related to component maintainability, reliability and testability through design change, revision and optimization.

Joint international effort of Aerospace and Defense Industries Association of Europe – ASD, and Aerospace industries Association of America – AIA, created set of specifications that is now in wide use in many industries and adopted by many countries.



Picture 1. ILS Overall business process, the S-series [1]

The S-series of ILS specifications is named SX000i and it is made of following:

Table 1. ILS S-Series specifications

S1000D	International specification for technical publications using a common source database
S2000M	International specification for Material Management Integrated Data Processing
S3000L	International specification for Logistic Support Analysis LSA
S4000P	International specification for developing and continuously improving preventive maintenance
S5000F	International specification for in-service data feedback
S6000T	International specification for Training Analysis and design

3. TECHNICAL DOCUMENTATION

Operation and maintenance of highly complex products, supporting equipment and systems from aerospace and defense industry is closely relying on thorough technical documentation support. Technical documentation in form of technical publications (electronic and/or paper) must provide user/operator with all necessary and relevant data.

3.1. S1000D Purpose and Scope

S1000D is defined as an international specification for the procurement and production of technical publications. It covers the process of planning, management, production, exchange, distribution and use of technical documentation that support the life cycle of any military and civil aerospace project, and as of issue 2.0 from year 2003 including land and sea vehicles or equipment. Latest issue is 4.1 published in year 2012.

The specification adopts concepts and standards of International Standards Organization (ISO), Continuous Acquisition and Life-cycle Support (CALS) and World Wide Web Consortium (W3C), in which information is generated in a neutral XML format. This means that it can be implemented on different and often disparate systems. Neutrality, added to the concept of modularization, makes the specification applicable to the wider international community.

Information produced in accordance with S1000D is created in a modular form, called a "data module". A data module is defined as "the smallest self-contained information unit within a technical publication". [1]

All data modules applicable to the Product are gathered and managed in a Common Source Data Base (CSDB). Key benefit of the CSDB is to enable production of platform-independent output in either page oriented or Interactive Electronic Technical Publication (IETP) form.

Data managed in S1000D is not duplicated in the CSDB. Data modules enable data to be stored only once and used for multiple outputs as necessary. A single change to an individual data module can update multiple outputs and multiple deliveries.

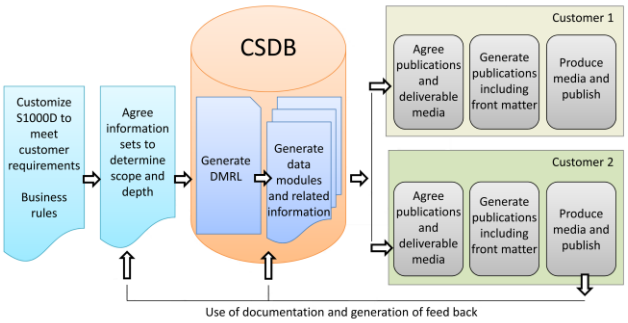
Other benefits of using S1000D are that:

- it is based on international neutral standards
- it reduces maintenance costs for technical information
- it transforms data into configuration items
- it allows subsets of information to be generated to meet specific user needs
- it facilitates the transfer of information and electronic output between different systems
- many different output forms can be generated from the same base data thus ensuring safety of data and that every user regardless of output form is getting the same message
- the S1000D data module concept can be applied to legacy data
- it is non-proprietary and allows neutral delivery of data and management of data

The specification addresses two main delivery methods of technical publications and training content packages:

- Data exchange - S1000D objects (data modules and supporting objects) delivery for further processing
- Publishing - Delivery of publications and training content packages - Information ready to use

3.2. S1000D Documentation process



Picture 2. Documentation process [2]

Prior to documentation creation in terms of authoring the technical content into data modules, it is necessary to perform several important customization agreements and steps.

S1000D specification has been produced to serve for many different types of products. Therefore, to make it suitable for a given project or organization, some aspects of tailoring will be required. It is common practice that the tailored version of this specification is referred to in the project's contractual documentation under section "Business rules".

An information set is defined as required information in a defined scope and depth in form of relevant data modules. Info sets are managed in the project CSDB. Data Module Requirements List (DMRL) is a list of all required data modules for that particular project. A publication is set of selected information published for certain customer.

Information sets are divided into three main groups:

- Common information sets
- Air specific information sets
- Land/Sea specific information

Common information sets provide following data:

- Crew/Operator information
- Description and operation
- Maintenance information
- Wiring data
- Illustrated Part Data (IPD)
- Maintenance planning information
- Mass and balance information
- Recovery information
- Equipment information
- Weapon loading information
- Cargo loading information
- Stores loading information
- Role change information
- Battle damage assessment and repair information
- Illustrated tool and support equipment data
- Service bulletins
- Material data
- Common information and data
- Training
- List of applicable publications
- Maintenance checklists and inspections

Upon defining a project specific information sets, and creation of DMRL, data modules are ready to be authored with technical, graphical, multimedia or even interactive 3D CAD content.

Depending on specific customer needs, selected compilation of information in form of data modules is published to a certain criteria in form of publication modules. Publication modules can have output format as IETP or paper whatever is requested by customer.

S1000D introduces these types of publications for aerospace industry products:

- Flight crew information
  - Flight Manual
  - Aircraft operational manual
  - Performance characteristics
  - Checklists
  - Quick Reference
- Loading and balancing the aircraft
- Maintenance
  - Aircraft maintenance
  - Aircraft description
  - Maintenance tasks
  - Maintenance checklists
  - Technological charts
  - Fault isolation procedures
  - Operational schematics
  - Electrical schematics
  - Maintenance interval planning
- Maintenance Requirements
  - Checklists
  - Technological charts
  - Typical technological logistics and engine repair
  - Engine Maintenance
  - Installation of the power plant
  - Maintenance of equipment
  - On-board equipment
  - Engine Equipment
  - Ground Accessories
  - Educational and training equipment
- Loading
  - Loading cargo on aircraft
  - Loading ordnance on aircraft
  - Loading inventory and equipment on aircraft
- Integrated services of aircraft
- Change of aircraft purpose
- Glider repair
- Non-destructive testing
- Corrosion protection
- Illustrated parts catalog
- Battle damage repair
- Rescue operations for the recovery
- Storage of aircraft
- Illustrated catalogs of tools and equipment
- General information Checklists
  - The structure of standard technologies
  - Type system technology
  - Typical technology for electrical / electronic systems
  - Normative documentation
- Data on materials
  - List of materials
  - List of Consumable materials
  - Data on materials with limited shelf life
- Service bulletins/Operational Information

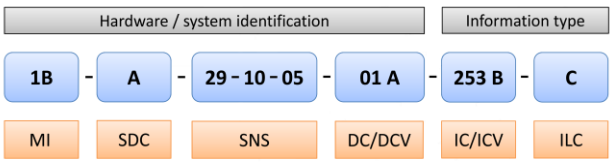
Documentation is subject to change due to feedback relation with products in service use. Key benefit of S1000D CSDB modularity concept is that any revisions on some data modules reflect through all publication modules, thus reducing time and cost of documentation republishing.

3.3. Data module code

Since CSDB in general is comprised of large number of data modules, their management is made possible by utilizing the data module code used to retrieve them or to gain access to them in an electronic environment.

The data module code is the standardized and structured identifier of separate data module and it is contained in its identification section. The data module code is part of the unique identifier of each data module.

Data module code is made of several sections of up to 41 alphanumeric characters in total.



Picture 3. Data Module Code example [2]

Partitions of data module code are following:

- Model identification code
- System difference code
- Standard numbering System
  - System code
  - Subsystem + sub-subsystem code
  - Unit or assembly code
- Disassembly code
- Disassembly code variant
- Information code
- Information code variant
- Item location code
- Learn code
- Learn event code

Coding of data modules is essential to provide precise information about what exact piece of hardware or system is undergoing specific maintenance action, with respect to where that action needs to take place.

4. APPLICATION OF S1000D ON LASTA AIRCRAFT

In 2015, company Cad Professional Systems (CPS) from Belgrade made joint effort with Military Technical Institute in Belgrade (VTI) to start a pilot project of the first introduction and implementation of S1000D specification in domestic aircraft industry. The trainer aircraft LASTA was selected for that purpose, and parts of wing structure were processed to obtain Illustrated Parts Catalog (IPC).

Software packages used for this purpose are leading industry solutions for creation and authoring of technical documentation by S1000D specification.

All technical illustrations were done using PTC IsoDraw converting existing or modeling new CAD data. Creation and management of Common Source Data Base (CSDB) and authoring of technical content was done using Technical Guide Builder – TG Builder 4.0 software developed by Applied Logistics.

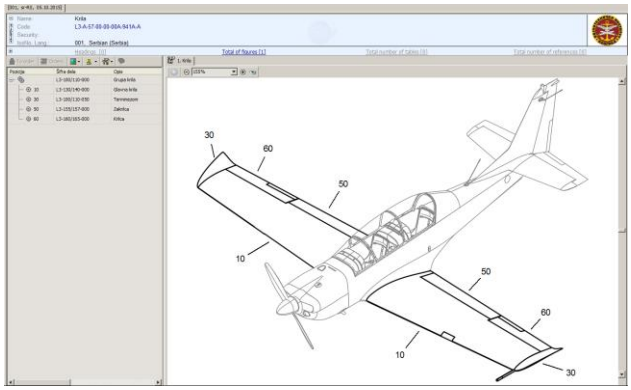
According to specification, technical description and maintenance manual [3], a Data Module Requirement List (DMRL) has been made for the aircraft in general. Furthermore, Standard Numbering System (SNS) was developed with detailed decomposition for section number 57 – Wings. Data module code was adopted to have 17 alphanumerical characters of length, with Model Identification assigned L3 for LASTA, with system difference code assigned A.

Adopting this project specific business rules provided elements necessary for creation of working template which is set of environment configuration parameters like logos, dictionaries, abbreviations etc. that are used in documentation. Based on developed working template, a CSDB structure was created.

Standard numbering system coding of section/system 57 was further developed for following subsystems and their sub-subsystems and units according to S1000D, issue 4.1, chapter 8.2.5 Maintained SNS - Air vehicle, engines and equipment [1]:

- 00 – General
- 10 – Center wing
- 30 – Wing tip
- 50 – Flaps
- 60 – Ailerons

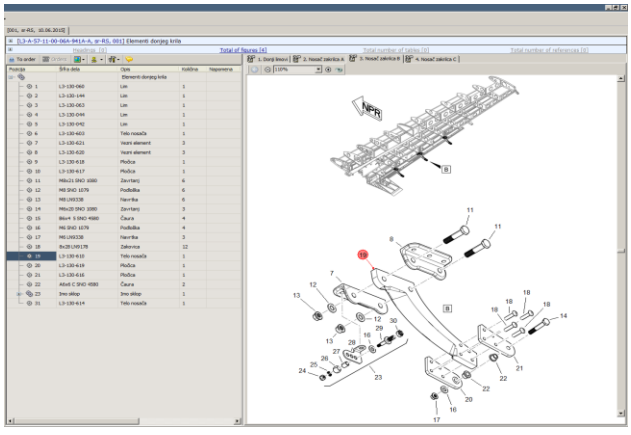
Picture 4. CSDB structure and system decomposition



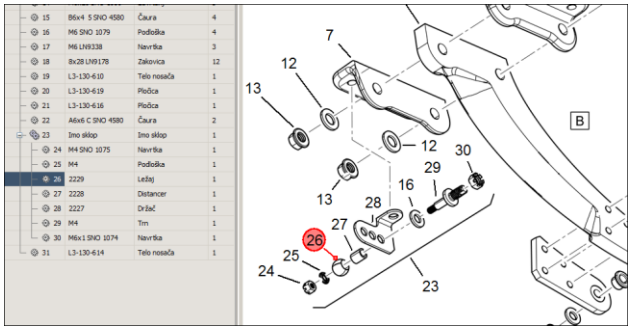
Picture 5. Wings decomposed

Illustrated Parts Data (IPD) structure was developed with standard and obligatory part attributes defined by specification. This attributes are item number, part number, description and quantity per next higher level of assembly. System also allows for numerous additional attribute fields customized as per needs of user/customer.

One of key benefits of using technical documentation in electronic data base form is that system provides easy part attribute search and sort functionality that can quickly provide information to user in comparison to old paper form documentation.



Picture 6. Part attributes in bill of materials (BOM)



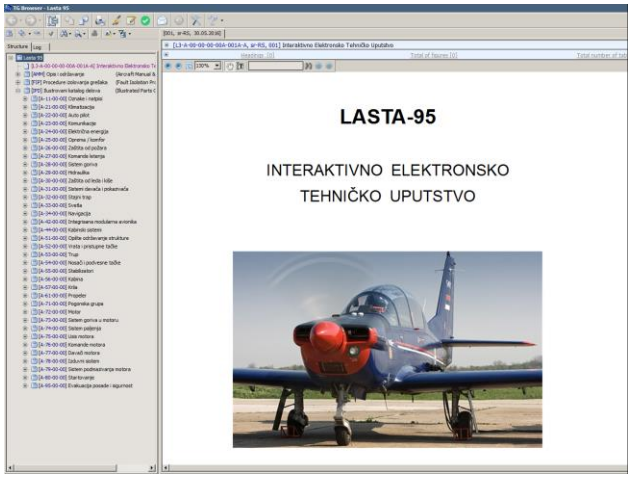
Picture 7. Interactive IPD BOMs

Parts in IPD can be searched either by attributes in a list, or directly from zoomable interactive illustrations. Hot point item numbers identify part attributes in a list, and vice versa. System also supports interactive 3D models in several formats instead of technical illustrations that can be rotated and manipulated for easier part identification.

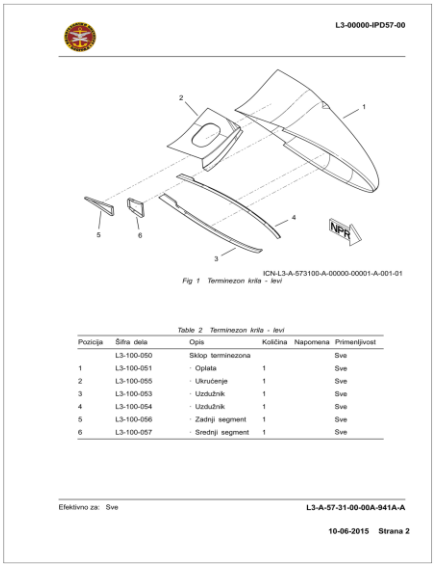
Illustrated Part Catalogs as S1000D information sets in general, can be produced in different levels of detail and depth, specific to customer needs. Once formed and data module populated SCDB, can be managed to provide technical publications for operational, maintenance or production level of detail all from one source. System can provide order lists for spare parts procurement.

TG Builder system provides possibility to reuse technical part of data modules written in one language, and to translate them in any number of data modules in another languages of choice. System can then be set to display all data modules in selected language environment. This significantly reduces cost and effort needed to produce multilanguage documentation.

Completed Illustrated Part Catalog for section 57 – Wings (Left wing) was published both in Interactive Electronic Technical Publication (IETP) and paper form. IETP is published in stand-alone and self-contained TG Browser format that can be viewed on any PC platform with Microsoft Windows operating system. Paper version is published in ISO A4 format with standard S1000D page elements and formatting. This formatting is unique for any S1000D compliant document worldwide.



Picture 8. LASTA 95 – IETP



Picture 9. Published print ready documentation

5. CONCLUSION

Implementation of S1000D in general brings numerous benefits. Time and cost of documentation production and maintenance are greatly reduced. Once produced, data modules of certain project can be reused in unlimited number of custom tailored publications due to the system modularity. Technical documentation takes unified and standardized form recognizable among different suppliers from different origins providing mutual interoperability.

Specification S1000D is one part of Integrated Logistic Support (ILS) system that significantly improves general combat readiness and ability to track and manage complex resources more efficiently. This project could be introduction and beginning of development of complete ILS system for aircraft LASTA.

S1000D specification alone, provides possibility to be implemented not only in domestic Aerospace industry like demonstrated by LASTA project. It can also be used for any land vehicle and artillery systems like LAZAR, BOV, NORA or infantry weapon systems and much more.

References

[1] Судов Е.В., Левин А.И., Петров А.Н., Петров А.В., Бороздин Д.Н. *Анализ логистической поддержки — теория и практика,* Прикладная логистика, Москва, 2014.

[2] S1000D - *International specification for technical publications using a common source database*, ASD-AIA, Issue 4.1, 2012.

[3] Vojnotehnički Institut - *LASTA Privremeni tehnički opis i uputstvo za održavanje*, VTI, Beograd, 2011.

[4] Н.Ю. Рубина, С.В. Сидорчук, *Технология разработки электронной эксплуатационной документации в системе TG Builder,* Прикладная логистика, Москва, 2014.