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PLM-driven S1000D

Extending the capabilities of S1000D in a joint PLM-CMS environment

White Paper

The Aerospace and Defense Industries Association of Europe (ASD) standard for technical publications establishes an international specification (Specification 1000D, or S1000D) that enables multiple organizations to consolidate documentation created on dissimilar authoring systems into a common database. S1000D is particularly valuable for supporting collaborative documentation development and delivering consolidated documents to disparate end-user communities. Teamcenter® software from Siemens PLM Software is ideal for reducing S1000D overhead by combining the capabilities of product lifecycle management (PLM) and content management systems (CMS) in a single environment that supports all of the participants engaged in designing, assembling and documenting large-scale, complex aerospace and defense systems.

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Executive summary

Large-scale, complex systems such as aircraft and military systems, platforms and infrastructures require multiple engineering, manufacturing and support teams to plan, develop, document, maintain and support their delivery. Just as importantly, documentation and configuration management capabilities must be available to all of these teams to manage the deployment, maintenance and operation of these systems and keep their cost and associated rework to a minimum.

Traditional product lifecycle management systems provide a widely accepted means for addressing the engineering side of these collaborative efforts. However, aerospace and defense contractors have historically used a variety of specifications, including those of the Air Transport Association of America (ATA) and the Aircraft European Manufacturers Association (AECMA), to manage documentation and post-deployment from a cross-discipline, enterprise perspective.

Even today, the process of consolidating documentation from different contributors and deploying maintenance-related job cards and training materials to field support groups continues to be handled on an individual basis by widely scattered organizations. To begin to address these uncoordinated functions, during the 1980s AECMA and the British Ministry of Defense developed a technical publications specification that merged multiple national and regional specifications into a single international standard largely based on ATA Specification 100.

The resulting standard for technical publications is specification S1000D.[1]

S1000D provides graphics format and structured text guidelines, as well as numerous reference and content usage guidelines, to enable multiple organizations to collaboratively develop modular documents and to deliver consolidated content to disparate end-user communities. The specification also provides business rules for the development, interchange, and delivery of those components.

In this scenario, the supporting environment leverages a common database to enable document contributors who employ different authoring systems to consolidate their documents in a modular form (data modules). These modules consist of two sections: one with content and one with identification and status data (metadata) necessary for controlling the data module and its configuration.

S1000D was released in 1989. By the late 1990s, the U.S. military had joined the effort to maintain a joint specification for global aircraft development. After 2000, the specification was extended to support the documentation of land and sea systems.

Today, S1000D is accepted in the United States by multiple defense groups, as well as the ATA. It is now often chosen over various earlier specifications, including ATA specifications 100 through iSpec 2200. Equally important, an increasing number of application vendors now provide support for S1000D authoring and publishing.

Unfortunately, two significant problems – both of which relate to the issue of entering S1000D metadata – still need to be resolved.

- Significant production overhead is required to support the modularity required by the S1000D specification
- Real-time configuration and content relationship information is required to describe the systems being documented

To address these overhead issues, Siemens PLM Software provides Teamcenter-driven content management capabilities that combine the advantages of PLM and CMS in a single solution that capitalizes on the synergy between engineering and technical publishing.

Teamcenter Content Management S1000D extends S1000D by improving the ability of aerospace and defense contractors to perform content management, content editing/updating, metadata management, document management, graphics management and document translation in the context of PLM and the product data.

Taking Advantage of S1000D

S1000D benefits

S1000D provides numerous benefits to both authors who develop technical content and the consumers who access and leverage technical documentation. For authors, S1000D delivers many of the business advantages of Extensible Markup Language (XML), including the ability to facilitate:

- Faster product deliveries by enabling authors to maximize content re-use, rapidly deliver finished content and easily repurpose and automatically format their documents.
- Interoperable content by enabling independent authoring groups to use their authoring tools of choice to create content that meets their own style and formatting guidelines and then transform this content to the interoperable S1000D publishing standard (alternatively, authoring groups can write directly to the S10000D specification).
- Disparate collaboration across a large-scale development project by enabling technical publication organizations to merge documentation from multiple sources (multiple vendors and subcontractors) into a consolidated document that covers the entire product.
- Reduced delivery costs by enabling authors to leverage commercial off-the-shelf (COTS) applications that provide S1000D interactive electronic training manual (IETM) and print support.

For documentation consumers, S1000D delivers interactive, context-driven content that consumers can import directly to a desktop, laptop or mobile device from interactive electronic technical publication (IETP) delivery applications, logistics and supply systems, and internal content and document management repositories. The uniformity and modularization of S1000D content enables product development organizations to boost content re-use across an entire information lifecycle that extends all the way to the technical manual end-user community.

Just as importantly, S1000D supports ongoing global collaboration and defense-standards initiatives by facilitating the use of simple English, which in turn reduces the need for local translation and improves technical document clarity for end-users.

Related overhead and production issues

In order to facilitate both content interchangeability and the use of context-driven content, S1000D eliminates the hierarchical nature of traditional content and organizes this information in one of several document module (DM) types, including descriptive, procedural, fault information, illustrated parts data, process and other related chunks of information.

Each of these data items is individually managed in two parts: the actual content and identification/status information (which includes various types of metadata that determines the access rights and configuration controls for the data module).

The process associated with generating this metadata is especially daunting, as voluminous amounts of metadata and numerous options must be written into S1000D data modules. Typically, the use of a content management system (CMS) is required in order to support these modules, manage their related versions, define their access rights and filter the metadata between various collaborators.

S1000D is a comprehensive and complex specification, which is still evolving; Version 4.1 is over 3,600 pages long. Few manufacturing companies need all of the components and metadata included in the specification. In fact, the process of preparing the S1000D specification for any given project usually requires the manufacturer to make multiple decisions about what elements and attributes of the specification need to be used.

However, regardless of what choices are made for any particular S1000D project, product teams find themselves having to manually write metadata into the project's data modules.

As the specification continues to evolve, development groups look for opportunities to re-use the document's content for additional purposes, including training that has to comply with Sharable Content Object Reference Model (SCORM) standards and for diagnostics that comply with European and U.S. standards. As support for additional functionality is required, the complexity of the metadata process will grow.

Another level of complexity is added to this process since S1000D requires document teams to assign and use a data module code (DMC). The DMC is a standardized and structured data module identifier that appears as a portion of the DM identification section and is part of the unique ID (UID) for the data module.

This identifier is used to access and manage content within the common source database (CSDB) that document delivery systems utilize to manage UIDs across all S1000D programs.

As the accompanying diagram illustrates, the DMC is logically assigned and based on several key components. Manual entry, and even pick lists for entering this information into the DM, introduces significant risk and potential rework into the publication process.

Generic structure of the data module code (DMC)[2]

Taken together, these considerations are driving today's product teams to reduce overhead by automating two processes:

- Content management support
- Metadata population and management

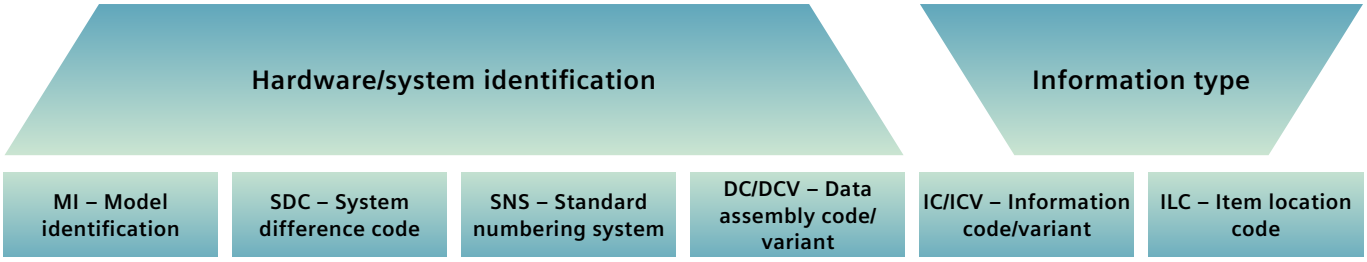
Content management support

Many companies that use S1000D already are simplifying the document type definition (DTD) used by their writers while trying to maximize the use of the S1000D standard. These companies want CMS applications to automatically move and consolidate information between dissimilar publishing systems during the collaborative process they use to develop technical documentation for highly complex aerospace and defense systems.

Leading-edge companies are especially interested in CMS applications that leverage workflow management capabilities to support multiple lifecycle states, document types, context-based content and role-based accessibility. These more powerful CMS applications offer major advantages over traditional CMS applications that only manage versions and relationships.

Metadata population and management

One of S1000D's major advantages is its ability to handle the implied relationships between product structure and parts data. However, documentation teams invariably need to enter information relative to part numbers, configuration and effectivities into the content they write. Typically, this information resides in different locations within a company, such as in its engineering, enterprise resource planning (ERP) and CMS environments. This complexity increases S1000D overhead by raising the issue of information redundancy and all of the risks associated with storing interdependent information in separate systems.



PLM-driven S1000D

The value of Teamcenter content management capabilities

Addressing the technical publication process

Teamcenter's content management solutions, including Teamcenter Content Management S1000D, have extended today's PLM environment with robust collaboration capabilities especially tailored for technical publications groups. Teamcenter enhances its traditional engineering collaboration capabilities with the benefits of structured authoring and standards-based publishing, including the ability to:

- Re-use technical content between both multiple document types describing a single product and documents supporting a product's variants
- Streamline the technical publication process with dynamic publishing techniques
- Facilitate consistent content structure and presentation
- Manage the content's translation, including the relationships between source and translated content and the management of translation workflows and vendor workflows

Reducing S1000D complexity

Teamcenter also reduces S1000D process complexity, enabling product teams to create relationships between engineering source content and technical publication DMs. This cross-domain integration enables product teams to:

- Establish relationships between information previously retained in multiple systems, thereby facilitating consolidated content that can be re-used for multiple purposes
- Automate functions and processes common to both the engineering and publications domains
- Capture the metadata of both joint technical data (JTD) and DM objects and manage it in a single location
- Relate the Simple Notification Service (SNS) used by technical writers to both the documents and illustrations they create and the product structure that provides their source data, significantly reducing the research time spent finding design and change information

Teamcenter facilitates a PLM-driven environment that supports re-use within the publications environment, as well as between S1000D content and the engineering source that provides a system's technical data. Teamcenter drives a streamlined publication process that enables technical documents to be developed in concert with the product development process.

This shared environment enables companies to reduce the S1000D overhead associated with manual metadata entry, as well as the risk associated with redundant data entry. Teamcenter allows a direct relationship between a product's part/assemblies (bill of material or configuration) and the text/graphics that comprise the S1000D content. This relationship is so close and complete that – even prior to S1000D – many publications groups used part numbers as metadata for classifying their content within their CMS.

Equally important, the engineering change orders (ECOs) that drive the modification of mechanical, electrical, electronic and software models/codes also drive changes made against both print and interactive technical publication content/graphics. While ECOs and their related discussions and authorizations/approvals are tracked by PLM-driven engineering environments, technical publications groups have a similar need to monitor and manage annotations and approvals within S1000D content and attributes.

Teamcenter's content management solution includes automatic notification capabilities that enable the PLM environment to determine which specific parts or logistics data is affected by a design or process change. These notification capabilities are especially valuable since they free technical writers from having to manually research a design change and determine its impact on any given DM.

Besides managing the relationships between parts, their technical data, and the S1000D documentation that supports them, Teamcenter enables product teams to implement other automated processes, including:

- Automated change impact notification (based on where-used queries)
- Automated metadata entry into DM content (based on the relationships between a DM and the product structure)
- Rapid documentation of product variants (configuration-driven document builds)
- Incorporation of other engineering source data, including manufacturing processing instructions and logistics support analysis records (LSAR) data, which overlap with S1000D content

Now, in addition to relationships, the Cortona3D RapidAuthor technical publishing applications provide the ability to re-use the PLM XML and JT™ data created in the design and supporting engineering processes directly. Technical writers can map this source data directly into text as well as 2D/3D illustrations and animations, providing a draft that is accurate to the product configuration because it was derived from the product configuration. As change happens, writers can review the design change, and choose to update their text and illustrations as applicable - RapidAuthor provides the ability to map the updated data into the original DMs and Illustration control numbers (ICNs), and generate the updated version. Because this information is coming from the product information and being created in the same authoring session, callouts, part numbers and text are all linked as the author creates the data, without the author having to run additional processes to create those links.

Extending S1000D content to other areas

Once the relationships between engineering data and technical documentation are established, companies can leverage Teamcenter and Teamcenter Content Management S1000D to automatically incorporate other engineering source materials directly into documentation content. For example, part data can be imported directly into illustrated parts catalogs or maintenance procedures – with the extra bonus of programmatically identifying relevant illustrations immediately after engineering changes are identified. This approach enables product teams to assemble customer-specific publication content based on effectivities directly derived from product structure effectivities.

S1000D content can be built on the basis of part and assembly options, language or any other criteria relevant to today's product management needs. These capabilities are especially valuable for facilitating the rapid publication of product variant documents.

Teamcenter solutions allow publication groups to relate documentation content directly to part and assembly configurations. Most importantly, they can use these dynamic relationships to affect the DM content. By enabling both engineering and technical publications to use these shared information capabilities, Teamcenter positions today's companies to move closer to a true solution for efficiently re-using their product-related intellectual assets.

Including S1000D content within the PLM environment also positions Teamcenter users to extend that content directly into their maintenance, repair and overhaul (MRO) and aftermarket support domains. Companies also can re-use S1000D technical manuals as job cards or leverage them as is and make them available to depot and tarmac maintenance crews. In turn, product teams can use Teamcenter's MRO capabilities to track comments and change requests from these crews and feed them back to the company's engineering and document authoring groups for incorporation into product design and S1000D content. This process closes the loop while retaining all relevant data within a single environment.

References

1. International Specification for Technical Publications Utilizing a Common Source Database, Issue 4.1 S1000D-I9005-01000-00 2012. For detailed information on the S1000D specification, visit www.S1000D.org.
2. Ibid.

Siemens PLM Software

Headquarters
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
USA
+1 972 987 3000

Americas
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
USA
+1 314 264 8499

Europe
Stephenson House
Sir William Siemens Square
Frimley, Camberley
Surrey, GU16 8QD
+44 (0) 1276 413200

Asia-Pacific
Suites 4301-4302, 43/F
AIA Kowloon Tower, Landmark East
100 How Ming Street
Kwun Tong, Kowloon
Hong Kong
+852 2230 3308

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