Supplier Collaboration: Industry-Proven Solutions for the Aerospace and Defense Industry

Model-Based Collaboration

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CIMdata, Inc.
Ann Arbor, MI USA
+1 734.668.9922
www.CIMdata.com

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Abstract: Large aircraft manufacturers are moving to model-based processes for collaboration with their partners and suppliers. CIMdata's work with the Aerospace and Defense PLM Action Group highlights the challenges these companies face and their requirements for an improved solution. Siemens Digital Industries Software's collaboration and supplier management solution address those concerns.

Introduction

"If you don't have standardized processes, how are you going to provide a consistent way to automate them?"[1]

Collaboration among Original Equipment Manufacturers (OEMs) and their product design and manufacturing engineering partners and suppliers is critical to executing any major aerospace and defense (A&D) program. In the past, product developers have been seriously hindered by relying on traditional, document-based development processes. One of their major business challenges is to achieve OEM and supply chain collaboration through bidirectional exchange of Technical Data Packages (TDPs)[2] using digital tools and model-based processes. However, there are many facets to this challenge that must be addressed. Siemens Digital Industries Software provides a model-based digital thread approach built on its Xcelerator portfolio.[3]

The A&D PLM Action Group defines a Technical Data Package as any collection of information defined by the recipient's requirement obligations. The collected technical data is gathered at a specific lifecycle stage. The technical data package describes the contents in an organized way.

In 2014, four leading OEMs—Airbus, Boeing, Embraer, and Gulfstream—joined together under the administration of CIMdata's PLM Community Program to form the A&D PLM Action Group with the intent to prioritize and plan for remediation of common PLM pain points through informal discussions.

[1] See SupplyChainToday.com

[2] This information may include, but is not limited to, engineering data, purchasing data, manufacturing data, certification data, test data, service data, etc. Some examples of these types of data are design definition, test reports, administrative agreement, installation instruction, component maintenance manual, etc.

[3] Research for this paper was partially supported by Siemens Digital Industries Software.

The Action Group has since grown to seven member companies.[4] Among the goals of the Action Group is promoting standard industry PLM processes and practices and defining requirements for common interest PLM-related capabilities. In 2017 the group turned a sharp focus toward global collaboration. A workgroup of subject matter experts (SMEs) from the member companies was established to identify the roadblocks in their collaboration processes and define requirements for remediation.

A&D PLM Action Group goals include promoting common processes and defining requirements.

Supply Chain Collaboration Challenges

From their day-to-day experiences, the SMEs who manage supply chain collaboration for their respective companies shared their common pain points. The workgroup members were quick to emphasize the constant level of collaboration across each product development phase, from ideation, through design and manufacturing, on into service. Their supply chains play an important role in each phase.

Many members highlighted the collaboration dilemma caused by each supplier using different processes and tools. Managing the variations and numerous tools was a challenge, often leading to errors and delays. Since many of the tools did not record and track collaboration operations, engineers were burdened with remembering individual data requests from collaborating companies. Often, the OEM's Request for Proposal (RFP) and the supplier's response were document-based with no traceability to the OEM's individual requirements. Communication was ad-hoc using email.

Teams often work on different model revisions.

The group's next most serious concern centered on revision control issues caused by the myriad data repositories used for collaborations. Many noted frequent revision clashes could be avoided if all stakeholders used up-to-date models. A careful distinction must be made here between data exchange via a paper 2D drawing as commonly used in the past, the digital 3D model data packaged in a file for transfer today, and the future goal of sharing real-time model-based data directly with each collaboration entity. Model data packaged in a file for transfer quickly becomes out-of-date after its creation, since design work continues with updates to the model.

As design content grows, the demand for product data collaboration also grows. In a study of their internal collaboration processes, PLM Action Group members found the most intense collaboration occurs among OEM remote sites and between design and build suppliers. Members also found the volume of

[4] The A&D PLM Action Group had eleven members at its height in 2020, but with the pressures imposed by the global pandemic, four members have withdrawn for financial reasons.

collaboration data peaks when performing simultaneous design and evaluation and digital mock-up (DMU) baselining. Further examination revealed the greatest amount of collaboration occurs within joint project repositories located inside the OEM's firewall. While many of today's collaboration processes remain file-based, a slow move toward direct, digital data sharing points to potential future improvements with a cloud-based solution.

Intellectual property (IP) also raised its head as an issue for both OEMs and suppliers. Often, engineers within a company are unclear what content represents IP since it is often not labeled in the design data. They are faced with the need to identify and protect that data. The problem becomes more complex when it is the responsibility of the OEM to separate each supplier's IP data. Defense projects, which require compliance with government regulations such as ITAR[5] and EAR,[6] compound the difficulty of IP management between OEMs and suppliers even further.

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Positioning the Product Development Ecosystem

The transportation industry as a whole is undergoing a major upheaval because of the global pandemic and its financial impact. Simultaneously, the industry is experiencing pressure to reduce program costs and shorten schedules. Yet, even as companies deal with these pressures, a continued increase in program complexity is further complicating supplier relationships. As in many industries, aerospace and defense suppliers are getting squeezed to help drive profits for the OEMs. Close tracking of a program's status is essential. Lack of program status visibility and missing the need to take corrective action can seriously affect a program's overall cost profile.

Suppliers are getting squeezed to help drive profits for the OEM.

Digital data rights protection is also increasingly important due to concerns around IP security and heightened export control regulations for defense, as well as environmental considerations. In response to growing product complexity, together with a demand for increased quality, many in the industry are calling for bold action to address these challenges. They are looking to digital content sharing and cloud-based processes for the answer.

There is a call for more program discipline and insight to suppliers' processes and status. Evolving processes to design and test must address a "system of systems" approach. The emerging concepts of digital twins and the digital thread, connecting all product information across the domains and different phases of the product lifecycle, take center stage. Companies must transform their existing information silos into digitalized data repositories, enabling new business value through end-to-end connectivity and optimization to support supplier collaboration.

[5] ITAR: International Traffic in Arms Regulations
[6] EAR: Export Administration Regulations

Efficiency, standardization, and automation will be the keys. As stated in the opening of this paper, *"If you don't have standardized processes, how are you going to provide a consistent way to automate them?"*

The Siemens Solution

The Siemens Digital Industries Software supplier collaboration solution provides a platform for bidirectional communication and real-time status visibility between OEMs, partners, and suppliers, starting with product definition and continuing through design engineering, manufacturing, and support. As shown in Figure 1, Siemens delivers a complete process-driven, end-to-end supplier management solution. The basis of their solution relies on the precepts of a model-based approach to share data, not documents, and digital twin models linked through a digital thread.

The Siemens supplier collaboration solution provides a platform for bidirectional communication and real-time status visibility between OEMs, partners, and suppliers, starting with product definition and continuing through design engineering, manufacturing, and support.

Figure 1—Collaboration Interaction
(Courtesy of Siemens)

Siemens Supplier Collaboration and Management digital thread is composed of solutions within their Xcelerator portfolio. Xcelerator is a comprehensive, integrated suite of software, services, and application development platform designed to help companies become digital enterprises. These cloud-based

solutions are available via Siemens Xcelerator as a Service powered by service providers, such as Amazon Web Services (AWS), see Figure 2.

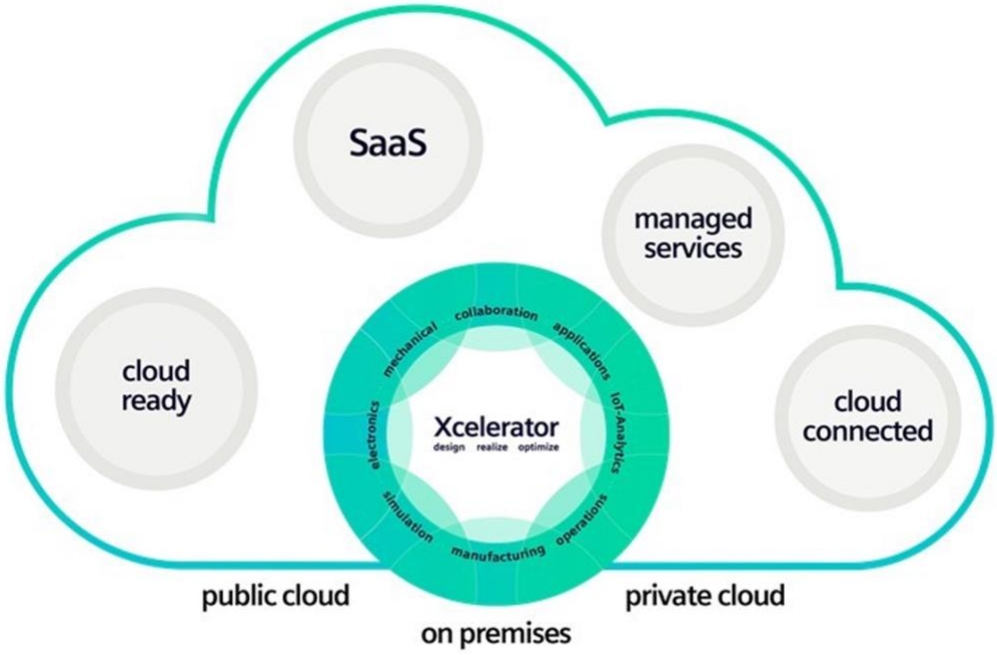

Figure 2—Siemens Xcelerator as a Service
(Courtesy of Siemens)

A Model-Based Approach

There is a broad shift within A&D product development away from discrete files to 3D digital models and data for all aspects of product design, manufacture, and support. By sharing digital data across the supply chain, companies can facilitate accurate and specific communication. The digital approach enables an always up-to-date virtual twin of the product along with its related requirements, manufacture, and support data.[7] Stakeholders will no longer need to worry about working from an outdated or modified file because only the most current, approved version will be made available.

CIMdata defines the Digital Twin as a physics-based description of a system resulting from the generation, management, and application of data, models across the system's lifecycle.

The full digital product model contains requirements information, engineering specifications, simulation, analyses, manufacturing setups, and support considerations. At the core of the model-based approach is the 3D product model definition, consisting of the mechanical shape. However, it allows for links to additional data content such as product requirements, engineering formulas, electrical schematics, software definitions, material specifications, analyses results, and manufacturing considerations that are stored in alternate data repositories throughout the enterprise.

The management of the supply chain throughout the product lifecycle can be a challenge. The mix of suppliers evolves as product lifecycle advances, with some

[7] The Digital Twin is more than just a descriptive model or collection of related digital information. It is a complete physical description including all behaviors.

suppliers added for the design phase, then removed once the product enters manufacturing. Once the product moves into service, different suppliers may again be added for operations and maintenance. In a model-based approach, the single source of truth can be maintained throughout this evolution within the product's digital twin.

Digital Twins Linked by Digital Thread

CIMdata defines the Digital Thread as the communication framework that connects data flows, which can be used to produce an integrated and holistic view of an asset's data from physical and virtual systems (i.e., its digital twin) throughout its lifecycle across traditionally siloed functional perspectives.

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Data authored or generated at each stage in the product's lifecycle can be connected by means of the product's digital thread. For example, using the digital thread, product requirements can be linked to actual deliverables from the supply chain.

With Xcelerator, a digital thread can enable the exchange of any type of data between the OEM and supplier. This data can include requirements, CAD models, simulation and analysis models, manufacturing simulations, and part information. Siemens reports that using their Supplier Collaboration and Management digital thread to manage the OEM/supplier relationship reduces costs, improves on-time delivery rates, and reduces the risk of miscommunication.

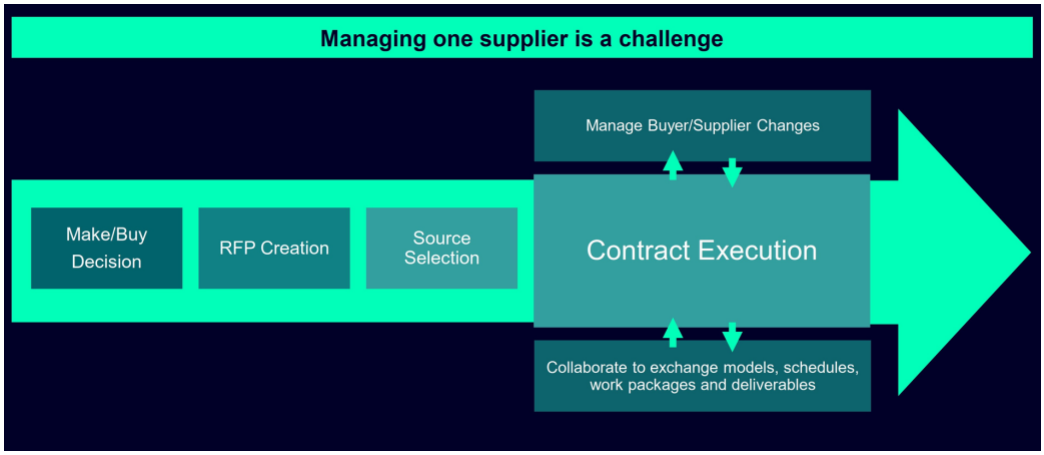

Figure 3—Siemens Supplier Collaboration and Management Solution
(Courtesy of Siemens)

The Siemens Digital Industries Software supplier collaboration solution supports the complete supplier management process. Beginning with a model-based supplier selection procedure that streamlines the make/buy decision, RFP creation, and choice of supplier. During contract execution the Siemens solution manages an integrated supplier schedule, deliverables, and production capacity. The solution provides for and oversees the exchange of digital data to and from the supplier while managing data rights for exchanged data.

Siemens supports supply chain communication by coordinating specific versions of a model that can be updated by the OEM and the supplier, when required. All

the necessary information is packaged and sent collectively, rather than piecemeal sharing of information. The data content tends to be more accurate because a digital model can include the contextual and referential supporting details the supplier may need.

The Siemens digital thread approach facilitates the secure and controlled sharing of digital product assets through programmatically enforced IP protection, export control, and ITAR compliance. OEMs and suppliers mutually benefit from more efficient processes for sharing while still protecting each company's data rights. Automated protections within the Siemens software track and validate whether a supplier or individual is authorized or licensed to view specific data. Additionally, licenses can be configured with an expiration date using an advanced version of digital rights management to automatically enforce content protection policies.

The Siemens digital thread approach facilitates the secure and controlled sharing of digital product assets through programmatically enforced IP protection, export control, and ITAR compliance.

Conclusion

Collaboration between OEMs and their product design and manufacturing engineering partners and suppliers is a critical aspect of any major aerospace and defense program execution. Product developers have been relying on file-based development processes. To improve OEM/supplier communication in the future, the industry is turning to digital tools and model-based processes.

The Siemens solution is the Supplier Collaboration and Management digital thread from their Xcelerator as a Service portfolio. By using Xcelerator and its suite of software services, companies can apply an integrated and model-driven approach to supply chain management. By using the digital thread for improved collaboration and oversight, Xcelerator supports a model-based process that builds the comprehensive digital twin to link requirements to source selection and all contract deliverables throughout the product lifecycle.

Siemens Xcelerator supports a model-based process that builds the digital twin linking requirements to contract deliverables.

The solution provides exchange of granular model-based data to the supply chain, including program management, systems engineering, design, manufacturing, and support data, using a flexible and open ecosystem. In addition, with data rights management companies can ensure intellectual property protection for exchanged data throughout the supply chain

About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design, deliver, and support innovative products and services by identifying and implementing appropriate digital initiatives. For nearly forty years, CIMdata has provided industrial organizations and providers of technologies and services with world-class knowledge, expertise, and best-practice methods on a broad set of product lifecycle management (PLM) solutions and the digital transformation they enable. CIMdata also offers research, subscription services, publications, and education through certificate programs and international conferences. To learn more, visit www.CIMdata.com or email info@CIMdata.com.