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3D Technical Data Use in Procurement

Revision 1

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Bottom Line Up-Front
This project employs demonstration pilots to validate military service methods of furnishing modern technical data to DLA, ensuring DLA can continue to do business as usual in a dynamic environment. The series of projects of which it is part are enabling DLA to operate in a 3D model–based enterprise with the rest of DoD.

Executive Summary

Technical data packages (TDPs) contain the foundational data used to manufacture, procure, and ensure the quality of Class IX parts. As engineering and manufacturing capabilities and techniques evolve and modernize, the format and content of TDPs must change as well. Over the last few decades, industry has been transitioning to computer-aided design (CAD) and computer-aided manufacturing, which produce and rely on three-dimensional (3D) model–based technical data.

The Department of Defense (DoD) has been slow to embrace this transition, causing typical DoD and Defense Logistics Agency (DLA) standards for technical data to disengage from those of the industrial base. In addition, the transition is accelerating, meaning DLA needs to quickly determine how it will do business using 3D model–based data. This project is the latest in a series that seek to give DLA a solid, repeatable process for executing procurement and other core business processes using 3D model–based data and the technical knowledge to adapt to emerging industry trends.

DLA's concept of operations for the use of 3D technical data prioritizes the use of neutral data formats that do not require new software or impede competitive procurement. A 3D Portable Document Format (PDF) file—in conjunction with a Standard for the Exchange of Product model data (STEP) file—meets DLA's requirement for neutrality.

This project focuses on launching more model-based TDP pilots with various engineering support activities (ESAs), project management offices (PMOs), and other DLA stakeholders to do the following:

1. Promote the use of 3D PDF and STEP files as a suitable neutral format for TDPs from DLA stakeholders.

2. Investigate alternative approaches and technologies to providing TDPs in neutral format, thereby expanding the number of DLA-validated neutral formats.

3. Advocate for the use of model-based technical data the meet the needs of DLA and other sustainment stakeholders across the DoD enterprise.

The nine pilots tested various methods for producing 3D PDF and STEP file–based TDPs from proprietary CAD models as well as Jupiter Tessellation (JT), Creo View (pvz), and Hypertext Markup Language revision 5 (HTML5) technologies and methods for providing neutral technical data to DLA and its vendor base. These pilots executed a typical DLA cataloging and procurement process (without awarding contracts), verifying that each chosen combination of technologies and processes met DLA's requirements.

They resulted in detailed best practices for using each combination and revealed potential challenges and ways to avoid them. Table ES-1 summarizes the technologies used.

Table ES-1. Pilot Technologies

ESA/PMO partner	DLA MSC partner	Proprietary format	Interpreter	Neutral format
U.S. Army TARDEC	DLA L&M	CATIA	Tetra 4D	3D PDF and STEP
U.S. Army ECBC	DLA L&M	Solidworks	Solidworks MBD Plug-in	3D PDF and STEP
U.S. Army NSRDEC	DLA L&M	Solidworks	Solidworks MBD Plug-in	3D PDF and STEP
U.S. Air Force Hill AFB (A-10 PMO)	DLA Aviation	N/A	OEM produced	3D PDF and STEP
NSWCPD (Columbia Class)	DLA L&M	Siemans NX JT	N/A	JT (JT2GO)
NSWCPD (Columbia Class)	DLA Aviation	Siemans NX JT	N/A	JT (JT2GO)
AMRDEC	DLA L&M	CATIA	N/A	Neutral viewers including CreoView, Brave, and Opentext
DCMA	DLA L&M	Siemans NX JT	N/A	JT (JT2GO)
Newport News Shipbuilding	DLA L&M	CATIA	N/A	HTML5

Note: AFB = Air Force Base; AMRDEC = Aviation and Missile Research, Development and Engineering Center; DCMA = Defense Contract Management Agency; ECBC = Edgewood Chemical Biological Center; L&M = Land & Maritime; NSRDEC = Natick Soldier Research, Development and Engineering Center; NSWCPD = Naval Surface Warfare Center Philadelphia Division; OEM = original equipment manufacturer; TARDEC = Tank Automotive Research, Development and Engineering Center.

Each pilot covered the generation of a TDP, visualization and extraction of data from a neutral file TDP, and visualization and extraction of data from a TDP in its native format. Training, testing, and use of several different viewer software packages helped ensure DLA could perform its required jobs with these new file formats and viewers.

These pilots clearly demonstrated that DLA's push toward a 3D model–based enterprise is feasible, that ESAs can generate 3D technical data that enable DLA activities to fulfill their various functions, and that DLA can use ESA-generated 3D data to procure what it needs. They also documented their suitability for Class IX procurement for future use by DLA and its stakeholders across DoD and the industrial base.

The project team expects DLA to continue this series of projects, maturing its ability to manage and operate in a 3D model–based enterprise as DoD continues to modernize:

- Through the research and development (R&D) project, "Connecting the Model-Based Enterprise," DLA will test its ability to connect directly to ESA/PMO product life-cycle management systems to exploit service-managed authoritative technical data, permitting DLA to dramatically speed up the 339 process. This will greatly increase the velocity and volume of technical data DLA can access,

improve its connection to the services, and make Class IX procurements faster, more accurate, and less costly.

- Through the R&D project, "Technical Data Solutions," DLA will demonstrate the value of model-based technical data to internal and external stakeholders with hands-on demonstration capabilities that can scan, convert, and execute using model-based data. This project also will assess the value to DLA of the emerging market of neutral viewer technology and offer a succinct best practices guide to service ESAs/PMOs and other stakeholders looking to submit 3D model–based TDPs to DLA.

These two efforts, among others in various stages of development, will help make DLA a leader in the modernization of DoD technical data management and digital sustainment, ensuring DLA equities are well represented in emerging trends and next generation capabilities.

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Chapter 2
Introduction

This project reviewed and characterized technical data for Defense Logistics Agency (DLA)–managed parts and demonstrated neutral and model-based technical data formats with a variety of military service organizations.

Problem

Industry has transitioned to computer-aided design (CAD) and computer-aided manufacturing (CAM), which produce and use three-dimensional (3D) technical data. The military services, which provide technical data to DLA, have begun their own transition from two-dimensional (2D) drawings to 3D models. DLA's current processes are set up to use 2D technical data. A recent research and development (R&D) project identified a desired end state for Class IX items in which the military services furnish DLA a 3D technical data package (TDP) and an associated Standard for the Exchange of Product model data (STEP) AP203 file (complete and validated) that conveys the full design intent.[1]

DLA's current practices for requesting, receiving, and storing technical data are based on a paper standard developed decades ago. These practices are rapidly becoming obsolete as industry transitions to model-based enterprises (MBEs).

DLA does not track which weapon systems work exclusively with model-based technical data, and it does not know when to anticipate model-based technical data from these entities. This hampers its ability to communicate technical data with its customers.

DLA lacks the capability to handle technical data developed in proprietary CAD software formats and has no way of knowing whether models will be adequately annotated. In addition, the variety of proprietary CAD software packages in use by the military services prevents DLA from supporting all potential formats without significant investment in software licenses and employee training.

Recent updates to MIL-STD 31000, Department of Defense (DoD) Manufacturing Technology (ManTech) Program investments, service-sponsored case studies, and industry's pervasive use of CAD/CAM technologies affirm that model-based technical data will be the de facto data source of the future. DLA is preparing for this inevitability and has proven its own ability to receive and provide technical data for solicitations in a 3D Portable Document Format (PDF) plus STEP file format. This format enables easy access, reading, and intuitive navigation using low-cost, widely available software.

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[1] This was the STP 4-06, Model-Based Technical Data in Procurement, project under the R&D for DLA Supply Support II contract.

Background

LMI's recent engagement with DLA has yielded numerous insights into the limitations of DLA's current technical data practices as well as the value of working with model-based technical data. Two recent projects have rendered great value for DLA:

- **CONOPS (September 2014)**. This project gave DLA a concept of operations (CONOPS) for the use of model-based technical data and laid out the significant advantages of using neutral technical data formats. It also revealed the many challenges facing DLA in supporting all proprietary CAD software packages in use by the services and their original equipment manufacturers (OEMs). It described an effective approach to utilizing model-based data through neutral data formats that minimize DLA investment and maximize DLA's ability to support the military services.

- **3D PDF Demo (July 2017)**. Consistent with the CONOPS recommendations, DLA sponsored the 3D PDF Demonstration R&D task to prove that 3D PDF was an effective, low-cost, neutral technical data format sufficient for DoD needs. In collaboration with three service engineering support activities (ESAs), three DLA supply chains, and the Defense Contract Management Agency (DCMA), DLA employed its current procurement processes to buy real parts (strictly for R&D) in an operational environment using only a 3D PDF file and STEP file in lieu of traditional 2D drawings. The 3D PDF Demo proved that the ESAs, DLA, and its suppliers can effectively use a 3D PDF file and corresponding STEP file in their daily operations to facilitate and perform the procurement process.

Following the PDF Demo, this project expanded the DoD audience exposed to 3D PDF and the number of neutral technical data formats validated for DLA use.

Applicable Policy and Regulation

A model-based technical data environment is in line with the digital engineering strategy (DES), which the Office of the Deputy Assistant Secretary of Defense for Systems Engineering released in June 2018. The DES has the following objectives:

1. Formalize the development, integration, and use of models to inform enterprise and program decision-making.

2. Provide an enduring authoritative source of truth.

3. Incorporate technological innovation to improve the engineering practice.

4. Establish a supporting infrastructure and environments to perform activities, collaborate, and communicate across stakeholders.

5. Transform the culture and workforce to adopt and support digital engineering across the life cycle.

Model-based technical data promote all of these objectives.

A model-based technical data solution also aligns with the objectives of DLA's Strategic Plan 2018–2026. The plan calls for DLA to apply advanced technology and more robust data management practices. Specifically, DLA plans to transition toward "commercial IT solutions" and improve overall data collection and analysis capabilities to facilitate warfighter agility. A model-based technical data solution would streamline data collection

and provide a comprehensive source for the technical data that empower advanced data analytics, emerging technologies, and engineering/sustainment strategies.

DLA is also working to enhance its collaboration with industry and the services. Specifically, it aims to synchronize its efforts with regional commands and its customers through a single point of entry for all DLA support services. DLA also wants to work more with industry to extract the best solutions for the warfighter and identify technical vulnerabilities. An ideal state of model-based technical data would support DLA's single point of entry.

Model-based technical data would enable DLA to improve its accountability by increasing auditability, value innovation, and risk mitigation. In addition, model-based technical data can support other strategic plan goals, such as controlling cost, providing best-value solutions to customers, and meeting warfighter needs.

An environment that fully supports and utilizes model-based technical data would bolster these DLA policy objectives.

Objective

This project had three primary objectives:

1. Promote the use of 3D PDF plus STEP as an effective and efficient neutral technical data format across the services to better prepare the DoD enterprise for procuring parts in a model-based environment.

2. Investigate and validate potential alternatives to 3D PDF plus STEP for use by ESAs and project management offices (PMOs) unwilling or unable to make use of that format.

3. Advocate for the use of model-based technical data that meet DLA operational requirements throughout the DoD enterprise, minimizing risk to DLA operations.

Chapter 3
Approach

The team performed R&D activities jointly with DLA and numerous ESA partners to promote the use of neutral, model-based data that meet DLA operational requirements. This project spanned three overlapping phases:

1. **ESA/PMO outreach**. Identify ESAs/PMOs intending to provide DLA model-based technical data in the future and willing to partner with DLA. Conduct a 3D technical data assessment of each.

2. **Pilot or demonstrate model-based data**. In conjunction with selected ESAs/PMOs and other stakeholders, conduct a pilot or demonstration of a neutral, model-based data format or approach to validate that the chosen process or technology meets all stakeholder requirements.

3. **Advocate for DLA's operational requirements**. Attend pertinent forums and events and share DLA's lessons learned with other DoD and industry stakeholders, thereby advocating for DLA requirements.

Outreach to ESAs/PMOs

From the project start through December 2018, we reached out to more than 15 ESAs/PMOs. First, we wanted to discover the ESAs/PMOs that planned to provide model-based technical data to DLA; second, we wanted to identify potential pilot partners for phase 2 activities.

More than half of the ESAs or PMOs with which we communicated had not considered the challenges involved in providing DLA with model-based technical data and had not planned for delivery of model-based technical data beyond a notional level. In some cases, the ESA or PMO expressed surprise and appreciation that DLA was planning ahead for the inevitable delivery of model-based technical data.

Pilot Process

This effort involved executing two types of 3D model technical data conversion pilots: developing 3D PDF technology and providing insight for new procurement file formats. The developing 3D PDF technology pilots involved generating a technical data template and converting a proprietary CAD technical data file to a 3D PDF file. In contrast, the providing insight for new procurement file formats pilots entailed using and reviewing preexisting technical data in the new formats to ensure they could perform their respective jobs. All pilots began by studying the technical data used for Class IX weapon system parts, following an affirmative go/no-go decision by our DLA sponsors.

Each pilot followed a similar process, adapted to fit the individual technology piloted (Figure 2-1). Before pilot execution, the project team, in many cases, facilitated (1) the installation and configuration of the selected technology on all stakeholder systems and (2) the acquisition of training in the use of the selected technology.

Figure 3-1. Pilot Process Steps

Note: ATI = Advanced Technology International; AVN = Aviation; L&M = Land & Maritime; TD = technical data; TS = Troop Support.
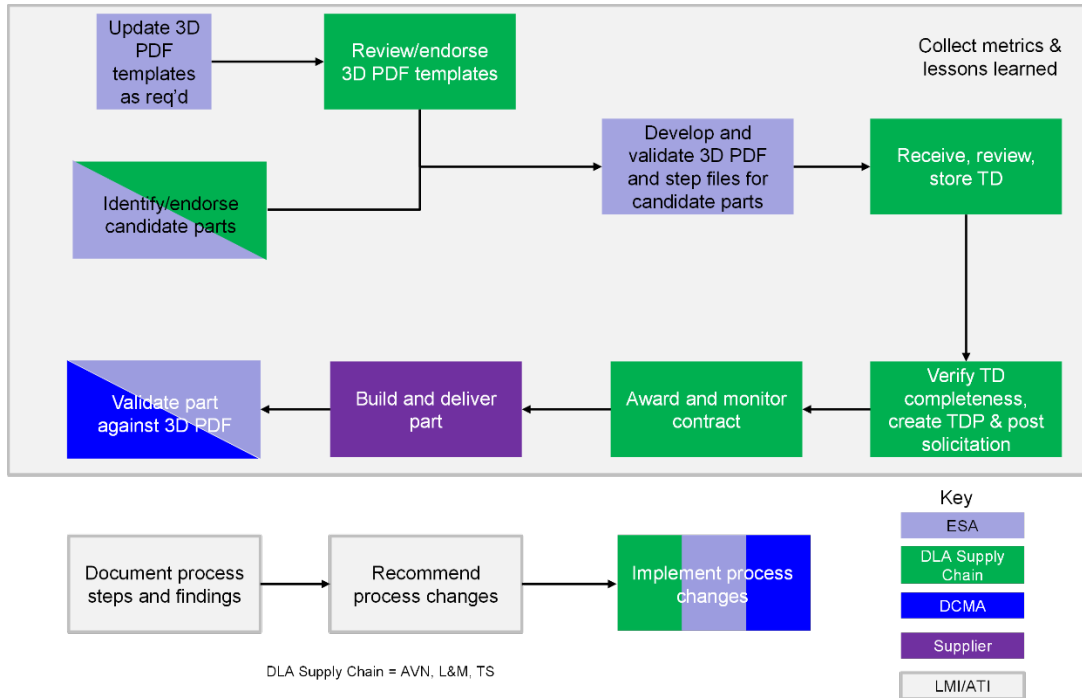
Technologies Piloted

This project piloted a set of neutral model-based data formats and software tools used to produce the individual data files. Table 2-1 shows the technologies investigated and piloted.

Table 3-1. Technologies Investigated and Piloted

ESA/PMO origination format	Conversion software	Neutral data format
Solidworks	Anark[a]	3D PDF plus STEP
	Solidworks Model-Based Design Plugin	3D PDF plus STEP
Creo	Tetra 4D	3D PDF Plus STEP
	Anark	HTML5
Team Center/NX	JT2Go	JT

[a] Piloted in the predecessor project; included here for reference.

Note: JT = Jupiter Tessellation; HTML5 = Hypertext Markup Language revision 5.

In addition to these technologies, the Aviation and Missile Research, Development and Engineering Center (AMRDEC) used several software packages that purport to be able to open and view model-based technical data in multiple proprietary formats without the need for conversion. (We detail this in that pilot section.)

Pilot Overviews

This section briefly describes each pilot's approach and the rationale for its inclusion. (Chapter 3 gives the results of each pilot, and the appendices include complete documentation.) We do not list the type of product used for each pilot: the validation process was intended to apply to any potential Class IX part procured using a TDP.

Table 3-2. Pilot Overviews

Site	Pilot purpose
ECBC	Using Solidworks + MBD Plugin develop 3D PDF template and test
NSRDEC	Using Solidworks + MBD Plugin develop 3D PDF template and test
TARDEC	Using Creo + Tetra4D develop 3D PDF template and test
Hill AFB	Evaluate 3D PDF + STEP/IGES
NSWCPD	Test JT file format using JT2Go Viewer
AMRDEC	Test Creo View and OpenText Desktop viewers for use in sustainment process
DLA Aviation	Test JT2Go for use in sustainment process
DCMA	Test JT2Go for use in the inspection and surveillance process
NNS	Test HTML5 for use in sustainment process

Note: AFB = Air Force Base; ECBC = Edgewood Chemical Biological Center; IGES = initial graphics exchange specification; MBD = model-based definition; NNS = Newport News Shipbuilding; NSRDEC = Natick Soldier Research, Development and Engineering Center; NSWCPD = Naval Surface Warfare Center Philadelphia Division; TARDEC = Tank Automotive Research, Development and Engineering Center.

ECBC

This pilot evaluated whether ECBC's plan to convert its technical data from a native file format (Solidworks) to a neutral file format (3D PDF + STEP) using Solidworks' MBD software could meet DLA's provisioning, cataloging, and sustainment needs.

We chose to pilot with ECBC because its personnel were highly enthusiastic about the pilot goals. ECBC also had sufficient technical data available to support piloting. Finally, we partnered with ECBC because, unlike the other pilot sites, it lacked an official process for converting TDPs into a 3D PDF format.

NSRDEC

This pilot evaluated whether NSRDEC's plan to convert its technical data from a native file format (Solidworks) to a neutral file format (3D PDF + STEP) using the Solidworks MBD software can meet DLA's provisioning, cataloging, and sustainment needs.

As with ECBC, DLA opted to pilot with NSRDEC due to its great interest and moderate level of technical data availability. Also, they did not appear to have a process in place for converting TDPs into a 3D PDF format. Most notably, NSRDEC expressed interest in collaborating with ECBC to develop the required templates.

TARDEC

This pilot evaluated whether TARDEC's plan to convert its technical data from a native file format (PTC Creo) to a neutral file format (3D PDF + STEP) using the Tetra4D Enrich interpreter can meet DLA's provisioning, cataloging, and sustainment needs.

DLA opted to pilot with TARDEC because it had high data availability and used PTC Creo as its 3D CAD platform. Further, TARDEC already owned a Tetra4D license and had plans to generate 3D PDFs using this software. Because TARDEC had not yet developed a 3D PDF template, this pilot encouraged it to move forward with this development. Finally, DLA selected TARDEC for piloting because the pilot would (1) validate the 3D PDF template and (2) explore the use of Tetra4D to produce 3D PDFs.

Hill AFB

This pilot validated that the existing processes for creating, distributing, and using technical data files within the A-10 Thunderbolt II Program Office at the Ogden Air Logistics Complex at Hill AFB in Utah met DLA's sustainment needs. DLA also wanted to determine whether the TDP development and distribution processes between the A-10 Program Office and DLA Aviation in Richmond, VA, are replicable across other DLA supply centers. To this end, DLA captured the steps taken by the engineering personnel at the A-10 Program Office to create and share 3D PDF + STEP/IGES technical data files with DLA Aviation.

NSWCPD

This pilot evaluated whether the JT2Go viewer could give NSWCPD adequate capability to integrate the JT + PDF technical data packages into its processes. The pilot demonstrated that the free version of the software, JT2Go, supports DLA's provisioning, cataloging, and sustainment needs.

DLA opted to pilot with NSWCPD due to the availability of its technical data, which it receives directly from the shipbuilder, Electric Boat (EB). Further, NSWCPD strongly supported a DLA pilot that would validate and test the feasibility of using the JT2Go viewer in downstream processes.

AMRDEC

This pilot evaluated whether OEM-provided CATIA technical data, which was converted to a PTC Creo View format, is viewable using the PTC Creo View, OpenText IMAGENATION 3D, and Brava viewers and provided feedback to ensure the technical data provided can meet DLA engineering and sustainment needs.

DLA chose to include DLA Aviation in the pilot because of its interest in pursuing the use of 3D technical data using PTC Creo View and OpenText Desktop Viewers, which are distinct technologies from those tested in the other pilots. Also, DLA Aviation showed interest in ensuring it would be prepared to receive technical data in this format. Moreover, AMRDEC expressed buy-in to ensure the technical data provided by AMRDEC was usable for sustainment activities.

DLA Aviation

This pilot validated whether DLA Aviation at Richmond can receive and view technical data in JT file format using the JT2Go viewer software and provided feedback to ensure the technical data provided can meet the DLA sustainment needs.

DLA chose to pilot with DLA Aviation because of its interest in pursuing the use of the JT2Go viewer for viewing JT files. In addition, DLA Aviation showed interest in ensuring it would be prepared to receive technical data in this format. In this pilot, DLA further sought to help DLA Aviation become familiar with Siemens' JT2Go viewer using technical data from the Columbia Class design disclosure.

DCMA

This pilot validated that DCMA can receive and view technical data in JT file format using the JT2Go viewer software and provided feedback to ensure the technical data provided can meet the DCMA inspection and surveillance requirements.

DLA chose to pilot with DCMA because of its interest in pursuing the use of the JT2Go viewer for viewing JT files. DCMA also showed interest in ensuring it would be prepared to receive technical data in this format. In this pilot, LMI/ATI further sought to help DCMA become familiar with Siemens' JT2Go viewer using technical data from the Columbia Class design disclosure.

NNS

We chose to initiate a pilot with NNS because of its interest in using HTML5 to use and visualize model-based technical data. The pilot ensures that NNS-created technical data in an HTML5 format can meet the needs of DLA's cataloging, provisioning, and sustainment needs. Other pilots focus on handing TDPs through a PDF file or JT file, but HTML5 works differently, delivering TDPs through a browser interface. More specifically, HTML5 is a markup language used for structuring and presenting content via a web browser. Along with specifying markup, HTML5 specifies scripting application programming interfaces (APIs) that can be programmed using the JavaScript language. One JavaScript API that makes viewing 3D geometry possible is called WebGL. The HTML5 format differs in three key ways:

- It is served via a web application server.

- It is viewed from a web browser.

- It is not a deliverable format but requires access to view.

At the time of the pilot, the only known mature vendor that produces 3D technical data via HTML5 is Anark.

This pilot is being executed in conjunction with the NNS ManTech project and is scheduled to go beyond the period of performance for the current contract between LMI/ATI and DLA. DLA approved the pilot and has agreed to transition its completion to future efforts in the planned follow-on project, Technical Data Solutions.

Chapter 4
Findings

ECBC

LMI/ATI conducted a full scope pilot with the U.S Army's ECBC. In this pilot, we worked with ECBC to generate a 3D PDF template and TDP using Solidworks and the MBD plugin. For its pilot of Solidworks MBD, ECBC generated a TDP for a door part assembly used in its Shop Equipment Welding System. In addition to producing 3D PDFs and the associated STEP files, ECBC documented its experience with the Solidworks MBD software for us, summarizing the pilot and assessing gaps.

In its summary, ECBC stated that the process of creating 3D technical data files in MBD Solidworks took twice as long as the process for creating 2D drawings. Specifically, for one representative at ECBC, it took 30 minutes to create a 3D model in MBD versus 15 minutes for a 2D drawing. According to ECBC, this time increase stems from the need to enter product and manufacturing information (PMI) directly into the model, which takes more time than creating sections and details on a 2D drawing. In its summary, ECBC further noted concern around the neutral file format's need for two files (PDF and STEP). Providing two files may create confusion or conflicts over which is the more essential or authoritative document. As the use of 3D PDF plus STEP increases, ECBC expects a correlated need to clarify processes and protocols to support its usage.

In its gap assessment, ECBC reported that the Solidworks MBD software is a functional solution for generating 3D PDFs and can meet its neutral file format needs. ECBC noted that the 3D PDF produced in MBD was professional in its overall presentation and that the process of generating a 3D PDF in MBD was simple overall. ECBC said it is ready to support future efforts in 3D PDF. ECBC noted MBD's limited flexibility of template structure, difficulty communicating engineering change proposals, small font sizes, view sizing limitations, lack of automatic tolerance updates, inability to transfer weld beads to the 3D PDF, and other publishing problems.

(Appendix A details ECBC's documentation and findings.)

NSRDEC

LMI/ATI conducted a pilot with the U.S Army NSRDEC in concert with ECBC because both sites were using the Solidworks MBD software. In this pilot, we worked with NSRDEC to generate a 3D PDF template and TDP using Solidworks and the MBD plugin. For its pilot of Solidworks MBD, NSRDEC generated a TDP for a latch part assembly that bolts onto a platform extraction bracket. In addition to producing 3D PDFs and the associated STEP files, NSRDEC documented its experience with the Solidworks MBD software, summarizing the pilot and assessing gaps.

In its summary, NSRDEC stated that the Solidworks MBD is a valid option for creating 3D PDF + STEP files that meet DLA's requirements for provisioning, cataloging, and sustainment. It also noted that including software providers and developers in the

template creation process was helpful. The team learned that Solidworks MBD is not as mature as Anark, which was used in prior pilots. NSRDEC periodically communicated with representatives from Solidworks to discuss problems and technology gaps, learning more details about the MBD product and providing feedback to Solidworks to help it enhance its product.

At the outset, we recommended the two sites develop a standardized, uniform template. We subsequently observed that the two sites chose to develop similar templates. Total standardization was not achieved, but this did not affect the project outcome. The lack of template standardization between the two ESAs appears to be driven by the fact that ECBC and NSRDEC are distinct business units that manage different parts under different schedules and with different operations. These differences led to the development of similar templates that work well within the respective business units.

In its gap assessment, NSRDEC reported that more flexibility is needed in the Solidworks MBD tables. It also noted that the representation of the template as you created it did not accurately reflect the final look once published.

(Appendix B details NSRDEC's documentation and findings.)

TARDEC

LMI/ATI conducted a pilot with TARDEC, converting its technical data from models in a native file format (PTC Creo) to a neutral file format (3D PDF + STEP) using the Tetra4D Enrich interpreter. For its pilot of Tetra4D software, TARDEC generated a TDP for a "test weldment" assembly. In addition to producing 3D PDFs and the associated STEP files, TARDEC documented its experience with the Tetra 4D Enrich software, including a summary, direct supply chain activity feedback, a gap assessment, and lessons learned.

In the summary, TARDEC noted that Tetra4D Enrich was an affordable software that did not require any programming experience. TARDEC found that the output created through this pilot adhered to technical data standards and best practices. It hopes to use the 3D PDF template created during this pilot for future 2D to 3D technical data conversion efforts. Although its overall experience with Tetra4D Enrich was positive, TARDEC noted several software limitations:

- Unable to import annotations in text cells

- Unable to import the system's parameters in text cells

- Unable to view solid welds in weldment combined views

- No print option to print selected views

- Annotations and geometric dimensioning and tolerancing (GD&T) do not appear in Tetra in the same orientation and location as in the native CAD files.

TARDEC noted the importance of sharing 3D PDFs with end users early and often (to help them get acquainted with the new file format) and stressed the benefits of engaging with software developers to provide feedback.

The supply chain activity representatives for provisioning, cataloging, and sustainment gave us detailed feedback regarding their ability to use the 3D PDF that TARDEC provided. The representatives found that, overall, the 3D PDFs contained sufficient data

and characteristics for them to do their jobs. They noted some missing elements that would have enhanced their experience with the TDPs, such as Commercial and Government Entity (CAGE) codes and notes. This missing information, however, did not prevent them from doing their jobs.

(Appendix C details TARDEC's documentation and findings.)

Hill AFB

This pilot validated that the existing processes for technical data file creation, distribution, and use within the A-10 Thunderbolt II Wing Replacement Program Office at the Ogden Air Logistics Complex at Hill AFB in Utah meet DLA's sustainment needs. LMI/ATI also wanted to determine whether the TDP development and distribution processes between the A-10 Program Office and DLA Aviation in Richmond, VA, are replicable across other DLA supply centers. To this end, we captured the steps the engineering personnel at the A-10 Program Office take to create and share 3D PDF + STEP/IGES technical data files with DLA Aviation.

From our observations throughout the pilot, as well as feedback obtained from the A-10 Program Office and DLA Aviation, we gleaned insights regarding DLA's transition to 3D PDF and the MBD Solidworks technology. Specifically, we found the process for generating a 3D PDF TDP at Hill AFB and DLA Aviation meets DLA's needs. We also learned that the output from the A-10 Program Office at Hill AFB and DLA Aviation differ slightly from other pilots. Finally, we found that the process for creating and distributing a TDP had limited documentation and relied in many cases on long-established personal relationships. That process stands to benefit from formalization and standardization.

(Appendix D details Hill AFB's documentation and findings.)

NSWCPD

LMI/ATI piloted with NSWCPD to determine whether the JT2Go viewer can give it adequate capability to integrate, within its processes, the JT + PDF TDPs. NSWCPD provided a TDP for training and to become familiar with the purpose of and how to use the JT2Go viewer. NSWCPD also provided a test TDP to be used by the cataloging, provisioning, and sustainment groups to ensure the technical data were sufficient to perform their jobs. The training TDP was for a piping plumbing missile compartment forward. The test TDP was for a logistic escape trunk upper hatch.

Overall, the DLA supply chain representatives determined that the JT + PDF produced during this pilot contained all of the necessary elements for carrying out provisioning, cataloging, and sustainment activities. They noted only minor issues. For example, the provisioning activity noted that navigating the JT2Go application was not intuitive and that training will be essential moving forward.

We arrived at multiple conclusions. First, we found great value in getting all of the pilot participants to talk to each other and collaborate. We also found the Adobe software and 3D PDF preferable to the JT2Go viewer and the JT file—primarily because the Adobe software enables users to save viewstate files and add annotations. The design disclosure concept for the Columbia class submarine is in development and has not yet been finalized. Finally, within JT2Go, no global identifier is consistently used to cross-

reference objects in the engineering bill of materials (EBOM) and the JT product tree. This adds a layer of complexity to the JT2Go software.

(Appendix E details NSWCPD's documentation and findings.)

AMRDEC

LMI/ATI conducted a pilot with AMRDEC and DLA Aviation. In this pilot, AMRDEC provided the required technical data to be tested and DLA Aviation at Richmond validated whether they could receive and view Creo View (.pvz) files using the OpenText viewer and Creo View Lite viewer.

Members of the DLA Aviation Creo View pilot program conducted the required testing. AMRDEC provided a TDP that contained native CAD files in CATIA, STEP Model Data AP203 files, and viewable files (.pvz). LMI/ATI and DLA Aviation testing used three viewers—OpenText Desktop, Creo View Lite, and Creo View Express. From the technical data received, the team consensus was that OpenText Desktop would not enable the team to perform their jobs in the technical quality, engineering, or product specialist areas.

When using Creo View Lite, the team reported it could view the.pvz viewable files and the STEP AP203 files provided by AMRDEC and deemed the testing successful. DLA Aviation did not test Creo View Express because it did not receive approval to load that software. LMI/ATI advised that the two software programs did not differ enough to pursue approvals.

AMRDEC concluded the pilot effort benefited them by identifying gaps that would need to be addressed before items could be procured solely through 3D MBD–produced technical data sets.

The J6 Enterprise Business Systems (EBS) Production Support team summarized its participation in the pilot. The Creo View viewer software was received by the J6 team but it ran into difficulties getting approvals to install it on its network. The DLA Aviation team suggested J6 consider loading the software on an off-network computer to perform testing. J6 agreed and submitted a work ticket to have the software installed on the off-network laptop at DLA Aviation. Because it was installed on an off-network laptop, J6 did not test the software.

(Appendix F details DLA Aviation's documentation and findings.)

DLA Aviation

LMI/ATI conducted a pilot with DLA Aviation to validate whether it could receive and view JT files using the JT2Go viewer software. We worked with NSWCPD to obtain the technical data required for testing. NSWCPD provided two technical data sets, one for use as a training guide (piping plumbing missile compartment) and the other for actual testing (forward and logistic escape trunk upper hatch operator). DLA Aviation documented its experience with JT files and the use of the JT2G0 viewer.

DLA Aviation noted that users did not have any issues opening or viewing the data. The data appeared adequate for procurement from a technical/engineering perspective. The

PDF file appeared to contain the data necessary for the product specialists, product data specialists, and engineers producing the part. The data included a distribution statement, parts lists, and associated information for the assembly.

DLA Aviation assessed the gaps in the technology. Users noted that the program was not as intuitive as other systems. More training or instruction should help users find features easier to use.

The J6 EBS Production Support team summarized its participation in the pilot. The JT2Go viewer was already approved for use on the DLA network. The J6 EBS team was asked to install and validate the technical capabilities of the JT2Go viewer from an IT perspective. The results of its testing showed JT2Go viewer was compatible within the DLA Virtual Desktop Infrastructure (VDI) network; however, some of the necessary files were not accessible. This viewer is used specifically for viewing JT files, so the files that were not accessible did not affect the pilot. Once its testing was completed, the team was required to provide access to those who would be performing the tests during the pilot.

(Appendix G details DLA Aviation's documentation and findings.)

DCMA

LMI/ATI conducted a pilot with DCMA to validate whether it could receive and view JT files using the JT2Go viewer software. We worked with NSWCPD to obtain the technical data required for testing. NSWCPD provided two technical data sets, one for use as a training guide (piping plumbing missile compartment) and the other for actual testing (forward and logistic escape trunk upper hatch operator). DCMA documented its experience with JT files and the use of the JT2G0 viewer.

In its summary, DCMA stated the users had issues opening the JT file using the link in the PDF file. The data appeared adequate for DCMA to perform quality checks and surveillance. The team could access required information from the PDF file, such as technical requirements, part JT Surface data files, assembly/manufacturing notes, engineering parts list, material comments, and detailed drawings, including all dimensions and tolerances.

DCMA concluded the TDP was adequate for its use, but the value of using the PDF in JT2GO in lieu of Adobe Acrobat is questionable. The additional solid model manipulation provided by JT2GO has little perceived value to DCMA. At the current time, JT2GO does not offer any additional required capabilities for DCMA not found in the PDF TDP.

DCMA assessed gaps in the technology. A definitive job aid (or potential training) would be required to equip the DCMA field personnel to use JT2GO.

LMI/ATI observed that the IT testing requirements are imperative prior to installing any new software on the DCMA network. The lead time for this action could be weeks or months. The IT department needs to be notified and involved early in the process to prevent delays.

(Appendix H details DCMA's documentation and findings.)

Newport News Shipbuilding

This pilot will extend beyond the period of performance of this project. This pilot is being executed in conjunction with the NNS ManTech project and is scheduled to go beyond the period of performance for the current contract between LMI/ATI and DLA. DLA approved the pilot and has agreed to transition the completion of this pilot to future efforts within the Tech Data Solutions project.

Chapter 5
Results

Lessons Learned

During our R&D activities to assist DLA and its ESA partners in adopting a 3D PDF solution, JT solution, and HTML5 solution for transferring technical data to support parts procurement activities, the team learned lessons across the pilots.

All the options tested for creating 3D PDF + STEP files that meet DLA's requirements for provisioning, cataloging, and sustainment were valid. Representatives from each of the supply chain activities involved in the ECBC and NSRDEC pilots found the TDPs created through Solidworks MBD met the requirements to support their respective functions, as did TARDEC representatives in their evaluation of Tetra4D. Similarly, the JT2Go viewer is a valid option for viewing a JT file format. It enables DLA Aviation users to view and find the data required to perform the engineering, technical quality, and product specialist functions. The process for creating and distributing TDPs at the A-10 Program Office on Hill AFB and DLA Aviation also met DLA's needs for supply chain support, though the 3D PDF output from the A-10 program differs slightly from that of other pilots in terms of presentation. The A-10 program's TDPs contain all of the critical information a TDP should contain (tolerancing, distribution statements, view-states, a notes section, etc.). However, the pertinent technical information in an A-10 technical part report is presented differently.

Including software providers and developers in the template creation process has value. During the pilot, we learned that Solidworks MBD is not as mature as Anark, which was used in prior pilots. ECBC, NSRDEC, and TARDEC periodically communicated with representatives from Solidworks and Tetra4D to discuss problems and technology gaps. We understand that the input stemming from this pilot will go before a software development team for review and, if possible, will influence the development schedule for the next versions of Solidworks MBD and Tetra4D.

Technical data templates do not need to be standardized to convey all of the information and technical data elements that DLA needs. The ECBC pilot began as a joint effort with NSRDEC. Our team observed that template standardization was not feasible but that the templates from both of the sites contained all of the necessary data elements to meet DLA needs. Before the pilot, TARDEC was similarly provided 3D PDF template examples from the U.S. Army Armament Research, Development and Engineering Center (ARDEC) Rock Island, Naval Air Systems Command Lakehurst, and Warner Robins AFB. TARDEC was asked to develop its template on the basis of the ARDEC examples. The template developed had much the look and feel of the sample templates, but we observed that template standardization, although desired, was not required. The success of TARDEC's non-standardized template indicates that ESA/PMO templates may not need to be fully standardized to support DLA operations. Following standards and best practices when creating MBD models may make it easier to develop a consistent template.

Clear guidance or precedence on cover markings in model-based data is lacking.
The provisioning representative from U.S. Army Tank-automotive and Armaments
Command notes that the TDP from ECBC lacked codes used to determine
demilitarization (DEMIL) codes, export control statements, and distribution statements.
These concerns, which may also extend to the classification level, raise questions about
how to include and manage markings in the MBE. As the use of 3D CAD models
becomes more prevalent, DLA may benefit from reviewing its plans for managing TDP
markings in the MBE and developing standard operating procedures around model
markings in 3D technical data.

Involvement of the IT department is a critical path for installing new software. IT
testing requirements and obtaining a certificate of networthiness are imperative prior to
installing any new software on a government network. The lead time for this action could
be weeks or months. The IT department needs to be notified and involved early in the
process to prevent delays.

Recommendations

Taken separately, each pilot produced recommendations as unique as each ESA
environment and the 3D PDF, JT, or HTML5 solution tested, but those observations form
the basis of best practices we recommend for all implementations in the future.

Update notation procedures for a 3D environment. During the ECBC pilot issues/gap
assessment, the LMI/ATI team noted that DLA may want to consider modifying
processes for the 3D environment. For example, rather than location change
geographically on the drawing, a mechanism needs to be developed to identify the
change using model attributes such as drawing number, CAGE code, or revision.

Document information flow to capture institutional knowledge. As observed, the Hill
AFB process had limited documentation and often relied on long-established personal
relationships. Stakeholders used email and secure file sharing through AMRDEC Secure
Access File Exchange (SAFE) to transfer data. As part of this pilot, we fully documented
all information flows and provided these to all stakeholders, providing back-up
documentation should a sudden stakeholder change occur. We recommend that DLA or
the A-10 Program Office use this documentation to create a job aid or other document
formalizing the process steps to ensure continuity and reduce risk in the long term.

Develop a prototype composite TDP. In this final report, we note that the lack of
template standardization in at least two pilots appears to be driven by the fact that ECBC
and NSRDEC are distinct business units that manage different parts under different
schedules and with different operations. We recommend evaluating the 3D TDP for
every pilot to develop a prototype composite template for a common specification and
then developing the appropriate TDP.

Include software providers or developers in the template creation process. As
mentioned under Lessons Learned, our team learned that Solidworks MBD is not as
mature as Anark, which was used in prior pilots. ECBC, NSRDEC, and TARDEC
periodically communicated with representatives from Solidworks and Tetra4D to discuss
problems and technology gaps. We understand that the input from this pilot will go
before a software development team for review and, if possible, will influence the
development schedule for the next versions of Solidworks MBD and Tetra4D.

Include ample training and user interaction when implementing a new software solution. The TARDEC users recommend setting up software training early on in the project for the entire project team. Give the team the opportunity to sit down with the software vendor and ask questions to avoid misunderstandings that can cause delays throughout the project. Also, share the new 3D PDF files with the widest circles of users to get them familiar with the new format and gauge its experience.

Develop a pilot project to analyze the full capability of viewers required by DLA to perform cataloging, provisioning, and sustainment activities. This pilot took advantage of viewers that were free or a trial version that was provided. The team found out quickly that free or trial viewers provide limited capability. Although these versions were able to provide positive results, the paid-for viewers will provide more capability, potentially enabling more file formats to be viewed with minimal software.

Chapter 6
Conclusion

This project demonstrates that DLA's move to a 3D model–based enterprise is feasible, that ESAs can generate 3D technical data that enable DLA activities to fulfill their various functions, and that DLA can use ESA-generated 3D data to procure what it needs. It also demonstrates the value of validating ESA/PMO processes intended to provide model-based data to DLA so procurement and warfighter support are not unduly delayed.

Chapter 6
Conclusion

This project demonstrates that DLA's move to a 3D model–based enterprise is feasible, that ESAs can generate 3D technical data that enable DLA activities to fulfill their various functions, and that DLA can use ESA-generated 3D data to procure what it needs. It also demonstrates the value of validating ESA/PMO processes intended to provide model-based data to DLA so procurement and warfighter support are not unduly delayed.

Appendix A
Edgewood Chemical Biological Center 3D PDF Pilot

Introduction

This pilot evaluated whether the ECBC's plan to convert its technical data from a native file format (SOLIDWORKS) to a neutral file format (3D PDF + STEP) using SOLIDWORKS MBD software can meet DLA's provisioning, cataloging, and sustainment needs.

The ECBC pilot was originally intended to be a joint pilot with NSRDEC. In executing a joint pilot between ECBC and NSRDEC, however, our team learned that they are distinct business units that manage different parts under different schedules and with different operations. Consequently, template standardization was not achieved. However, the team determined that template standardization was not required to achieve the DLA pilot goals. Ultimately, the pilots were parallel but independent efforts, operating on similar timelines and with similar oversight.

Roles and Responsibilities

Building, distributing, and validating a TDP required a series of steps and involvement from multiple stakeholders. The pilot team included representatives from the ECBC ESA, supply chain activities, and R&D contractors. Table A-1 lists the stakeholders and their roles.

Table A-1. Pilot Team and Roles

Organization	Role
LMI/ATI	Facilitator
U.S. Army Tank-automotive and Armaments Command (TACOM)	Provisioning
Logistics Information Services (LIS)	Cataloging
DLA Land & Maritime	Supply Center
ECBC	Data Provider

Figure A-1 illustrates the workflow and responsibilities for the ECBC-NSRDEC pilots. The R&D contractor team was comprised of representatives from LMI and ATI. LMI/ATI facilitated the pilot, documented the TDP creation process, conducted an initial TDP validation, reviewed deficiencies, identified and documented deficiencies, and collected and documented lessons learned.

Within the above workflow, ECBC was responsible for documenting the TDP creation process, generating templates, selecting technical data, creating the TDP, reviewing the TDP for deficiencies, and correcting deficiencies as needed.

Finally, the supply chain activities, including TACOM, LIS, and DLA Land & Maritime were responsible for reviewing the TDP for cataloging, provisioning, and sustainment

purposes. They were also responsible for documenting any deficiencies and sharing their feedback with the rest of the pilot team.

Figure A-1. ECBC-NSRDEC Pilot Process Workflow
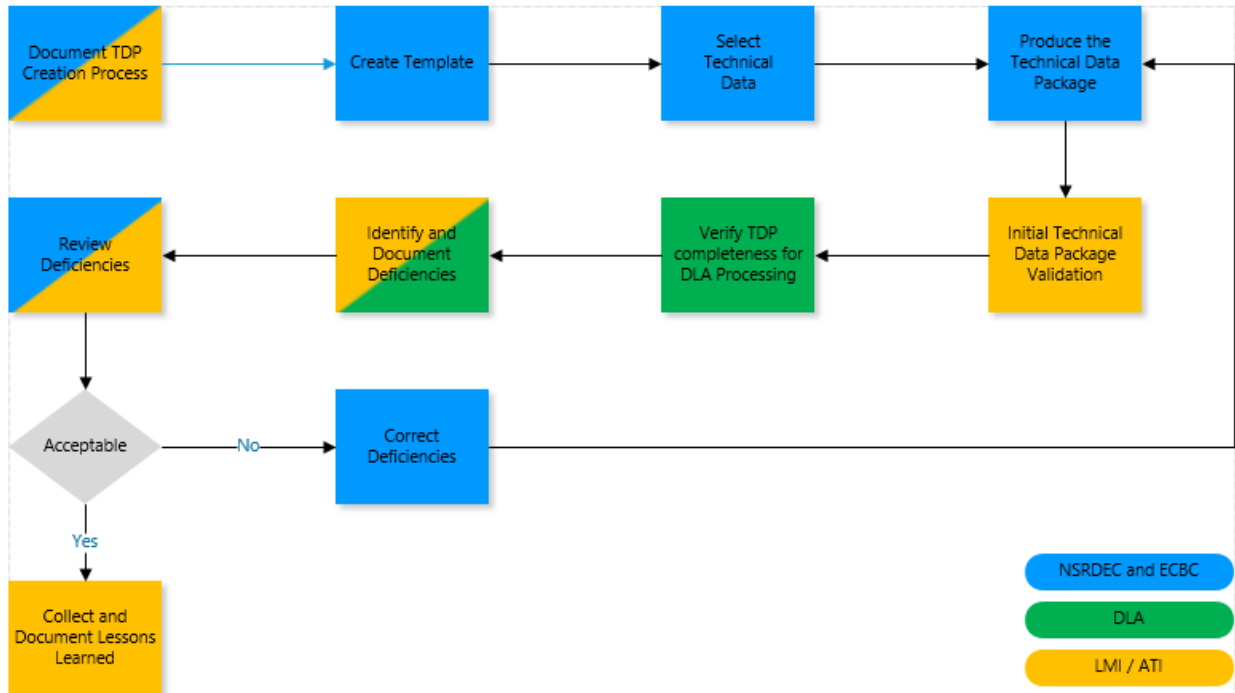
Schedule

The ECBC pilot ran from June 18, 2018 through December 7, 2018. LMI/ATI documented process and technology feedback throughout the project. Figure A-2 shows the ECBC Pilot schedule.

Figure A-2. ECBC Pilot Schedule
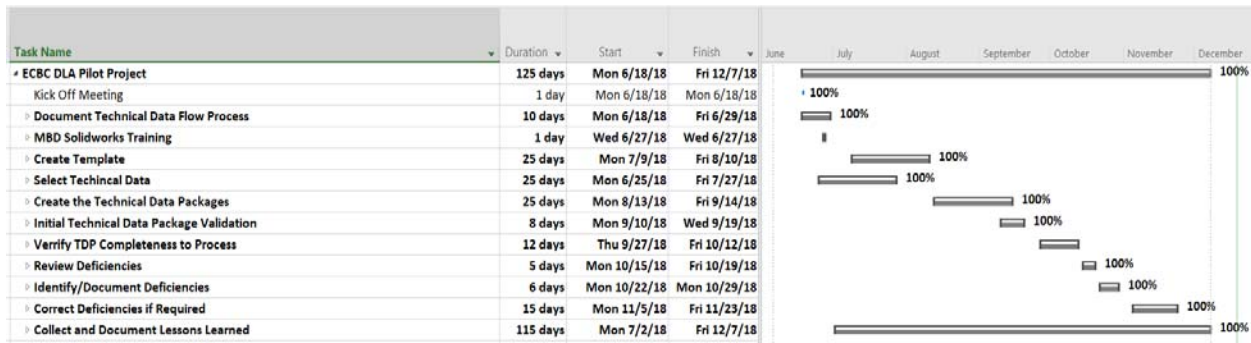
ESA Technical Data Survey

At the beginning of the project, LMI/ATI issued surveys to potential pilot partners. LMI/ATI used the survey responses to create a shortlist of potential pilot partners and presented the list to DLA leadership during a go/no-go briefing. After DLA approved the

pilot, LMI/ATI held a kickoff meeting with each partner. LMI/ATI maintained the survey responses, including the engagement survey and the responses received from ECBC, as shown in Table A-2.

Table A-2. ECBC Engagement Survey and Responses

1. Is your current technical data produced in a 3D format? If yes what CAD software package(s) do you currently use?
Product Manager, Sets, Kits, Outfits and Tools (PdM SKOT)—Yes, SOLIDWORKS Most Chem/Bio Data—No Advanced Design Manufacturing (ADM) is developing in SOLIDWORKS and Creo
2. If you do produce 3D models do you also produce associated 2D data?
PdM SKOT—Yes ADM—Yes
3. If you are providing 2D-only technical data, are there any plans to adopt 3D technical data?
PdM SKOT— Chem/Bio—We would like to; funding will be the issue ADM—Provides PMs with 3D and 2D data. Typically only provide 2D data to Buying community
4. If you are using 3D technical data, are you annotating Product and Manufacturing Information (PMI) to the model you are creating, i.e. GD&T, surface finish, notes etc.?
PdM SKOT—Not right now. Plan to move in that direction. ADM—Not right now. Plan to move in that direction.
5. Are there any programs/weapon systems under your authority for which only 3D technical data is currently available or will be available in the next 5 years? If yes, please identify the explicit program/weapon systems, when (month/year) they will enter the provisioning process (if applicable), and when they will begin seeking DLA support for sustainment.
N/A
6. Are there any programs/weapon systems under your authority for which legacy 2D data will be converted to 3D data and for which the ESA/PMO will no longer maintain and provide 2D data? If yes, please identify the explicit program/weapon systems and when (month/year) the transition will occur.
PdM SKOT—Not at this time Chem/Bio—Not at this time ADM—Not at this time
7. What types of file formats make up your TDP package that supports each of your programs/weapon systems, i.e. native CAD, 3D PDF, JT, Excel, etc.?
.cal, PDF, STEP, Native SOLIDWORKS, dxf, Gerber/patterns
8. Are there any programs/weapon systems under your authority that have adopted the use of 3D PDF for recording and distributing technical data? If yes, please identify the explicit program/weapon systems.
No
9. Is there any plan for programs/weapon systems under your authority to adopt 3D PDF for recording and distributing 3D technical data? If yes, please identify the explicit program/weapon systems that plan to do so.
Not that we're aware of. Biggest issue is conversion cost from 2D to 3D.
10. If you have programs/weapon systems that will not or cannot adopt a 3D PDF file format for technical data, have you given thought to what format you will use to provide technical data to DLA? If yes, please identify the specific file format(s) and explain your rationale for adopting that format.
We would like to embrace 3D PDF, but cost of conversion may be prohibitive.

11. Are you aware of the data elements that DLA requires in 2D or 3D technical data to support provisioning and procurement of weapon system parts?
Yes
12. Are you aware of the viewable/readable 3D formats that are acceptable by DLA for use in provisioning or sustainment?
Yes–3D PDFs
13. Are you interested in learning more about the research DLA has completed as it relates to recording and distributing 3D technical data?
Yes

Candidate Parts List

For its pilot of SOLIDWORKS MBD software, ECBC generated a TDP for a door part assembly used in its Shop Equipment Welding System. Table A-3 lists the seven piece parts selected for this pilot.

Table A-3. Door Assembly Piece Parts

Drawing Number	Nomenclature
11B4600005	Cabinet Door Weldment
11B4600054	Cabinet Door Type 1
11B4600203	Lock Hasp
11B4600496	Crowbar to Bracket
11B4600497	Crowbar Lower Bracket Part 1
11B4600498	Crowbar Lower Bracket Part 2
11B4600499	Crowbar Lower Mount

Pilot Summary

Based on our observations throughout the pilot as well as the feedback obtained from ECBC and the participating supply chain activities, our team gleaned several insights regarding ECBC's transition to a 3D TDP and the SOLIDWORKS MBD technology:

MBD SOLIDWORKS is a valid option for creating 3D PDF + STEP files that meet DLA's requirements for provisioning, cataloging, and sustainment. Representatives from each of the three supply chain activities involved in this pilot determined that the TDP created through SOLIDWORKS MBD met the minimum requirements to support their respective functions. Using the TDPs that ECBC generated, the provisioning activity would have been able to write a provisioning plan and contract data requirements that capture any additional technical data needs. The cataloging activity had all of the information necessary to establish and assign a National Stock Number (NSN). The representative from DLA Land & Maritime determined that the TDP contained all of the information required to support sustainment.

The representatives from the three supply chain activities noted some minor concerns with the output they reviewed. While some concerns related to clerical errors, others

revealed that the SOLIDWORKS MBD technology is not as mature as Anark was at the end of prior DLA-LMI demonstrations. These concerns may be assuaged in the future as the software becomes more mature and as ECBC becomes more familiar with using SOLIDWORKS MBD to generate 3D PDFs.

There is value to be gained from including software providers and/or developers in the template creation process. During the pilot, our team learned that SOLIDWORKS MBD is not as mature as Anark, which was used in prior pilots. ECBC periodically communicated with representatives from SOLIDWORKS to discuss problems and technology gaps. These communications resulted in the creation of service requests (SRs) and SOLIDWORKS Performance Reports (SPRs). It is our team's understanding that the SRs and SPRs stemming from this pilot will go before a development team for review and, if possible, will influence the development schedule for the next version of SOLIDWORKS MBD.

Technical data templates do not need to be standardized to convey all of the information and technical data elements that DLA needs. The ECBC pilot began as a joint effort with NSRDEC. At the outset, our team recommended that the two sites consider developing a standardized, uniform template. However, the two sites chose to develop separate but very similar templates and although total standardization was not achieved, its absence did not affect the project outcome. The lack of template standardization between the two ESAs appears to be driven by the fact that ECBC and NSRDEC are distinct business units that manage different parts under different schedules and with different operations. These differences led to the development of similar templates that match the preferences of their respective business units.

Nevertheless, the templates from both of the sites contained all of the necessary data elements to meet DLA's needs. Specifically, ECBC and NSRDEC's templates contained all of the information necessary for provisioning, cataloging, and sustainment (e.g., distribution statement, revision numbers, view states, dimensions, tolerances, etc.). Therefore, ESA/PMO template standardization is not necessary to support DLA's operations.

There is a lack of clear guidance or precedence to cover markings in model-based data. The provisioning representative from TACOM notes that the TDP from ECBC lacked assignment of codes used to determine DEMIL codes, export control statements, and distribution statements. These concerns, which may also extend to the classification level, raise questions about how to include and manage markings in the MBE. As the use of 3D CAD models becomes more prevalent, DLA may benefit from reviewing its plans for managing TDP markings in the MBE as well as developing standard operating procedures around model markings in 3D technical data.

The actual input from participants is included below in the engagement survey, the summary from ECBC, the candidate parts list, the feedback from the supply chain activities, and the gap assessment.

Pilot Team Feedback

ECBC

At the end of the ECBC pilot, LMI/ATI requested a summary of the pilot from the perspective of our points of contact (POCs) at ECBC. The purpose of having this summary was to obtain technology and process insights from ECBC, to assess the overall feasibility of the technology tested, and to formulate lessons learned. The direct summary from our POCs at ECBC is provided below:

The 3 Dimensional Intuitive Product Document Format (3Di PDF) pilot study offered the ECBC Design Engineering & Test Facility the opportunity to develop a template using SOLIDWORKS MBD and populate that template with an actual assembly part, the Door Assembly used with the Shop Equipment Welding system.

It is estimated that creating files in this format will take approximately twice as long as it takes to create 2D drawings. (See POC Input 1 below for more information.) It may be possible that as the MBD software matures and ECBC personnel gain experience utilizing the software, this timeframe can be reduced.

The benefits of 3Di PDF for procurement activities and their vendors are unknown as compared to offering the native CAD files or Standard Triangle Language (STL) to support Additive Manufacturing or IGES as a neutral file format to transfer data between similar CAD systems. (See POC Input 2 for more information.)

Nonetheless, ECBC stands ready to support future efforts regarding 3Di PDF provided there is adequate funding to do so.

POC Input 1: The statement that this process takes 2X longer than the current process I believe is correct. You are right I did say that the process for creating the PDF is "push button", and it is. However, to get the native SOLIDWORKS files into a position to create the "push button" PDF is what takes the extra time.

I have become relatively proficient with MBD and I know from personal experience creating 2D drawings that what would take me 15 minutes currently takes me 30 minutes in MBD. I know this because the files I used for the pilot are drawings I created recently for a new system we developed. I believe most of the time increase stems from entering the PMI in the model. This process does take more time then creating sections and details on a 2D drawing. I am sure that as the software matures method and tools will be incorporated and cut the time down on generating the PMI within the model. I envision that at some point SOLIDWORKS will be able to bring a certain amount of intuitiveness to the software like a predictive algorithm that would prepopulate some of the PMI into the model (dimensions and stuff). Once that happens I believe the time discrepancies will be eliminated, and potentially MBD could be a faster method.

POC Input 2: The IGES statement I believe needs some further explanation. The PDF, as far as I know, itself has no ability to be converted into any CAD product. The way to provide the model is to attach a neutral format file such as a STEP or IGES.

LMI/ATI comment: Most CAD systems cannot convert PDF into geometry but can import the PDF as an image that can be used as a decal or as a background for tracing.

Product Representation Compact and U3D data that are used to define the 3D view in a PDF document can be translated to other formats for use in a CAD system or other application. The type of 3D data in the PDF and the translator settings will determine whether the translated data is precise or tessellated. MBD basically allows the attachment of files by checking a block before producing the PDF. I think the "unknown benefit" comes from two things:

1. The effectiveness of a drawing that can be rotated/manipulated similar to what you would see in a CAD program.

2. Is providing a neutral format file a good thing? Providing two files makes it unclear which information is the driver (PDF or STEP). We currently don't send a file out like this unless it is required to build the part/assembly, and has been verified by engineering to be correct. Generally, the 2D drawing basically has little to no dimensional data. With this approach we have two possibilities:

    a. Only send verified STEP files for drawings that have limited dimensional data where the STEP is the dimensional driver (as we currently do), or

    b. Provide a STEP file with an MBD file with a caveat stating which information is the driver. You could argue that the model is the same in the PDF as the one used for the STEP. However,

        i. there are issues with converting to another CAD platform (generally they are pretty good, but in some cases have produced inaccurate information) and

        ii. there can be additional information on the PDF drawing that is not captured as PMI in the model.

Supply Chain Activity Feedback

Once developed, ECBC submitted its TDPs to the designated supply chain activities. In this pilot, the designated supply chain activities included TACOM, LIS, and DLA Land & Maritime. Each of these supply chain activities provided feedback on ECBC's TDPs and stated whether or not the TDP as delivered would support their respective duties. The actual feedback from the provisioning activity, the cataloging activity, and the supply center is provided below. See Table A-4 for guidance on how to read the feedback.

Provisioning (TACOM)

- These drawings provide the minimal requirements to begin planning for provisioning. We would treat 3D drawings the same as any other 2D Production drawings, and write a provisioning plan with contract data requirements that capture the remaining data we would need. Assuming a 3D drawing is equivalent to production drawings.

- Data we require for provisioning may not be provided up front on a TDP when using production drawings. OEM data including packaging and pricing with part number and cage codes comes after the contractor is in receipt of the drawings

and sources their manufacturing. This can be returned to the government with additions to the drawings, in the form of an LSA 036, or both.

- ECBC response: As far as quality, packaging, contract data requirement lists, and such we have ARDEC teams that fill in these sections for contracting efforts.

These samples address the following:

- Rights in Technical data with Distro Statement that helps assign AMC/AMSC codes and addresses Export Controls which helps determine DEMIL. Both are needed to assign codes on how these drawings are to be used for supply support.

- LMI/ATI comment: Does this go on 2D drawings? If so, it should be on the 3D PDF?

- ECBC Response: I think we are good. We have both the distro statement and export control on our drawings.

  - Identifies location of part with Next Higher Assembly, and the Assembly drawing had a list of components within that assembly. These are needed for placement within the system and developing J & K cards leading to RPSTL Development.

  - Has revisions block for tracking the assembly and parts through configuration control.

Cataloging (LIS)

1. 11B4600054—Appears to have adequate characteristics to establish an NSN.
2. 11B4600498—Appears to have adequate characteristics to establish an NSN.
3. 11B4600203—Appears to have adequate characteristics to establish an NSN.
4. 11B4600005—Need Material Characteristics, but other than that it appears to have adequate characteristics to establish an NSN.
   a. ECBC Response: Material can be added, and should have been captured on the drawing. This was just a clerical error and is shown on other drawings requiring material callout.
5. 11B4600497—Appears to have adequate characteristics to establish an NSN.
6. 11B4600499—Need Material Characteristics, but other than that it appears to have adequate characteristics to establish an NSN.
   a. ECBC response: Material can be added, and should have been captured on the drawing. This was just a clerical error and is shown on other drawings requiring material callout.
7. 11B4600496—Appears to have adequate characteristic to establish an NSN.

Global Comments pertaining to 3D PDF drawings:

1. If the request for new NSN or the request for maintenance action on an existing NSN reflects something other than what is on the drawing or the cataloger does not have the skillset/training to extract characteristics data/part numbers from the

drawing, that could be an issue. Essentially, there is a learning curve to distinguish how the request submitted matches the drawing and how to pull out the characteristics based on the means of delivery, format of the 3D data, etc.

2. I noticed there were parts lists within some of these drawings. What were those CAGE Codes for those parts of the assembly? If an NSN is going to be established does the request only reflect the drawing part number or will the expectation from a cataloging perspective be to drill down in the Reference Number Category Code/Reference Number Variation Code (RNVV/VC, D/9) drawing reference on the request to try and locate the parts being cataloged. Data elements/how a request is submitted will affect whether or not these pieces of data are adequate.

3. System-to-system compatibly, storage, and capability to attached/process 3D PDF's with NSN requests is a matter of concern as well. Can the 3D PDF's be attached to electronic catalog (ECAT) requests or Federal Logistics Information Services (FLIS) Portfolio Workbench/FLIS Portfolio Workbench Provisioning Module (FPW Prov Mod/FPW), records, etc? Can AMRDEC accommodate a complete EDFP [Engineering Data for Provisioning] package consisting of 3D PDF's or does another means need to be established to deliver them to support a provisioning effort and/or NSN assignment?

4. Source/Vendor Control nature of parts may need to be discussed as well depending on what the standard for 3D PDF is going to be regarding piece parts of an assembly. Reference Number Category Code/Variation Code (RNCC/VC) Coding on a LSA036 will indicate this, and if the tech data 3D PDF does not reflect the respective source/vendor control block with suggested/approved sources it may pose a problem cataloging the NSN.

Hope this info helps. Ultimately, just looking at them they could be used, but from my perspective the 3D data is only a piece of the puzzle and the standard by which it is read and transmitted and the way cataloging requests are submitted against each piece of data will play a large part in whether or not a 3D PDF is sufficient for cataloging purposes.

Supply Center (DLA Land & Maritime)

The positive features are:

- Distribution Statement is present.

- Revision date(s) present.

- Original signature date is present.

- Title block has dimension tolerances appropriate to the drawing data present.

- Dimensions are almost all present.

Areas for improvement are:

- The font size of dimensions on drawings 1184600005, and 00054 are too small. If you magnify the view large enough to read the dimension, you lose your reference points. The font size of dimensions on the other drawings is good.

- ECBC response: Font size is difficult to manipulate in MBD. We are using 2017 and I know 2019 is on its way. I believe this will be easier to change in the future.

- Title bloc—Font size for Item Name, DWG No., CAGE, and REV too small. There is plenty of room in these boxes to expand the text size for easier/faster review or input of the metadata for the drawing into the DLA Document Management System.

  - ECBC response: Font size is difficult to manipulate in MBD. We are using 2017 and I know 2019 is on its way. I believe this will be easier to change in the future.

- Drawing 1184600054 specifically is missing another material call out for the basic door to which the .125 AL edge strip is attached.

  - ECBC response: Material can be added, and should have been captured on the drawing. This was just a clerical error and is shown on other drawings requiring material callout.

Gap Assessment

In addition to soliciting DLA activity feedback, LMI/ATI requested a gap assessment from ECBC. The purpose of the gap assessment was to document the user experience for the tested technology. Having a better understanding of the user experience, including issues and impacts on output, allowed LMI/ATI to make an informed assessment and recommendation regarding the feasibility of the SOLIDWORKS MBD software for DLA. The gap assessment provided by ECBC is included below.

Notes

Generally speaking, SOLIDWORKS MBD software works very well and presents 3D technical data in a very professional manner. Template design is relatively easy to set up within the software, and creating a 3D PDF is basically a "button push" action to generate. I know that as the software is updated and improved, the functionality will only improve, but I do think there are a few issues. Some of these issues are easy fixes, but others may prove to be difficult to accomplish or require another methods to provide the same functionality as current SOLIDWORKS drawings.

Issues

1. Template structure: Currently, 2D drawings have templates that are "SOLIDWORKS" so once you created a drawing it becomes "unique." This allows changes we generally do to be done on the same template we use for all drawings in that size. Here is an example: we generally create "dash" drawings to accomplish this all we do is open the appropriate size template, insert the model, and then insert a table with rows and columns depicting the proper information. In MBD the template is generated into a PDF, and once it is created we can only make changes allowed in Adobe. To apply the dash example in MBD, this would likely be applied similar to BOMs, but the problem arises with how we provide spaces for the PMI without having a bunch of empty space when not used (we will get asked if there is missing information). There needs to be a way to put additional areas of information in without creating a template for a bunch of different scenarios. In my opinion, it would be best to have one or two templates

to keep things "common" and be allowed to manipulate the drawing after creation to meet our needs.

2. Tables: This may be fixed in newer versions, but we cannot use whole table.

3. Writing ECPs: There will be some issue with the current methods of writing and depicting changes without the alpha numeric grid we currently have on drawings. For example, we currently we use verbiage similar to this "CHANGE DIMENSION IN ZONE B3 FROM "45.25" TO "45.00" this is a pretty easy example, but you can imagine a more complicated issues spanning multiple views how do we describe these changes? Screen shots? This is something we need to work through to setup a method/standard that everyone agrees upon.

4. Font sizing needs to be more user friendly. MBD 2017 is difficult to manipulate, though I know that as the software matures it will likely be similar to or better than SOLIDWORKS drawings.

5. Sizing the views in MBD: It is very difficult to determine how the captured view in SOLIDWORKS MBD will display on the PDF once created (it's pretty much guess and check). After the PDF was created, it was easy to zoom in and out to properly fit the model in the viewport, but you cannot save that new look. I would suggest the ability to manipulate the PDF after creation as suggested in issue 1.

6. When user changes DimXpert Specific Global Tolerances, the tolerances on the model do not automatically update.

   a. Submitted SR(1-18440286287)

7. Weld beads do not transfer over to 3D PDFs, but do transfer to edrawings. Fillet Beads will transfer, but we cannot use them in assemblies.

   a. Submitted SR(1-18440286191)

   b. Customer must submit Enhancement Request.

8. Is there a way to autoscale viewports or create a border in SOLIDWORKS to easily scale viewports in 3D PDF? Currently, it is difficult to determine the appropriate zoom level in SOLIDWORKS that will fit appropriately in viewports in published 3D PDFs.

   a. Customer must Submit Enhancement Request

9. Revision table and titleblock expand after publishing to 3D PDF.

   a. SPR 1019102

10. Thumbnails do not resize/are oversized when published to 3D PDF.

    a. SPR 1019102

11. Can I automatically print all annotation views in 3D PDF.

    a. The only way to currently do this is to create an independent viewport for each annotation view in the template. You then publish to 3D PDF. Within the 3D PDF you can then select different annotation views for each independent viewport and then save 3D PDF. Next time you open the 3D PDF, your independent viewports will contain saved annotation view. The downside is you cannot save zoom level.

    b. Customer must Submit Enhancement Request.

Enhancement Requests to SOLIDWORKS

During the pilot, ECBC diligently provided feedback to SOLIDWORKS by submitting SRs and SPRs, and by directly contacting the SOLIDWORKS MBD product manager. Below are the responses and recommendations from SOLIDWORKS.

Notes

Issues

- When user changes DimXpert Specific Global Tolerances, the tolerances on the model do not automatically update

    - Submitted SR(1-18440286287)

- Weld beads do not transfer over to 3D PDFs but do transfer to edrawings. Fillet Beads will transfer but cannot use them in assemblies.

    - Submitted SR(1-18440286191)

    - Customer must submit Enhancement Request

- Is there a way to autoscale viewports or create a border in SOLIDWORKS to easily scale viewports in 3D PDF? It is difficult to determine the appropriate zoom level in SOLIDWORKS that will fit appropriately in viewports in published 3D PDFs.

    - Customer must Submit Enhancement Request

- Revision table and title block expand after publishing to 3D PDF

    - SPR 1019102

- Thumbnails do not resize/are oversized when published to 3D PDF

    - SPR 1019102

- Can I automatically print all annotation views in 3D PDF?

    - The only way to do this is to create an independent viewport for each annotation view in the template, publish to 3D PDF, and then select different annotation views for each independent viewport and then save 3D PDF. Next time you open a 3D PDF, your independent viewports will contain saved annotation view. The downside is you cannot save zoom level.

    - Customer must Submit Enhancement Request

Typically, if I can't resolve a customer issue, I submit an SR to SOLIDWORKS Technical Team, who will either show me how to resolve the issue or, if issue is Software related (a bug), then they assign the SR an SPR number which is then passed on to software development team. There are no timetables for when an SPR will be resolved. It will depend on several factors such as how many people are being impacted and how it affects customers.

Conclusions

Based on the documentation and results of the ECBC pilot, LMI/ATI drew the following conclusions:

1. ***SOLIDWORKS MBD is a valid option for creating 3D PDF + STEP files that meet DLA's requirements for provisioning, cataloging, and sustainment***. Representatives from each of the three supply chain activities involved in this pilot determined that the TDP created through SOLIDWORKS MBD met the requirements to support their respective functions.

2. ***There is value to be gained from including software providers and/or developers in the template creation process***. During the pilot, our team learned that SOLIDWORKS MBD is not as mature as Anark, which was used in prior pilots. ECBC periodically communicated with representatives from SOLIDWORKS to discuss problems and technology gaps. These communications resulted in SRs and SPRs. It is our team's understanding that the SRs and SPRs stemming from this pilot will go before a development team for review and, if possible, will influence the development schedule for the next version of SOLIDWORKS MBD.

3. ***Technical data templates do not need to be standardized to convey all of the information and technical data elements that DLA needs***. The ECBC pilot began as a joint effort with NSRDEC. Our team observed that template standardization was not feasible but that the templates from both of the sites contained all of the necessary data elements to meet DLA's needs. Therefore, ESA/PMO template standardization is not necessary to support DLA's operations. Following standards and best practices when creating MBD models may make it easier to develop a consistent template.

4. ***There is no clear guidance or precedence for covering markings in model-based data.*** The provisioning representative from TACOM notes that the TDP from ECBC did not assign codes used to determine DEMIL certifications, export control statements, and distribution statements. These concerns, which may also extend to the classification level, raise questions about how to include and manage markings in the MBE. As the use of 3D CAD models becomes more prevalent, DLA may benefit from reviewing its plans for managing TDP markings in the MBE and developing standard operating procedures around model markings in 3D technical data.

Appendix B
Natick Soldier Research, Development and Engineering Center 3D PDF Pilot

Introduction

This pilot validated NSRDEC's plan to convert its technical data from a native file format (SOLIDWORKS) to a neutral file format (3D PDF + STEP) using the SOLIDWORKS MBD software can meet DLA's provisioning, cataloging, and sustainment needs.

The NSRDEC pilot was originally intended to be a joint pilot with the ECBC. In executing a joint pilot between NSRDEC and ECBC, however, our team learned that they are distinct business units that manage different parts under different schedules and with different operations. Consequently, template standardization was not achieved. However, the team determined that template standardization was not required to achieve the DLA pilot goals. Ultimately, the pilots were parallel but independent efforts, operating on similar timelines and with similar oversight.

Roles and Responsibilities

Building, distributing, and validating a TDP required a series of steps and involvement from multiple stakeholders. The pilot team included representatives from NSRDEC, supply chain activities, and R&D contractors. Table B-1 lists the stakeholders and their roles.

Table B-1. Pilot Team and Roles

Organization	Role
LMI/ATI	Facilitator
TACOM	Provisioning
LIS	Cataloging
DLA Land & Maritime	Supply Center
NSRDEC	Data Provider

Figure B-1 illustrates the workflow and responsibilities for the ECBC-NSRDEC pilots. The R&D contractor team was comprised of representatives from LMI and ATI. LMI/ATI facilitated the pilot, documented the TDP creation process, conducted an initial TDP validation, reviewed deficiencies, identified and documented deficiencies, and collected and documented lessons learned.

Within the above workflow, NSRDEC was responsible for documenting the TDP creation process, generating templates, selecting technical data, creating the TDP, reviewing the TDP for deficiencies, and correcting deficiencies as needed.

Finally, the supply chain activities, including TACOM, LIS, and DLA Land & Maritime were responsible for reviewing the TDP for cataloging, provisioning, and sustainment purposes. They were also responsible for documenting any deficiencies and sharing their feedback with the rest of the pilot team.
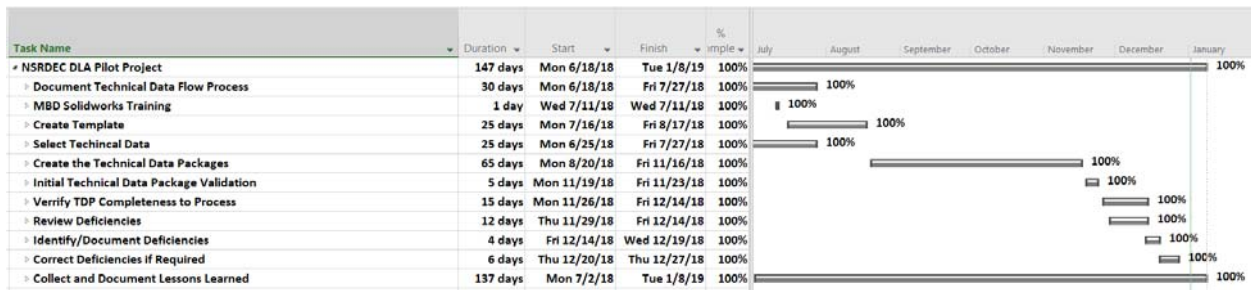
Figure B-1. ECBC-NSRDEC Pilot Process Workflow
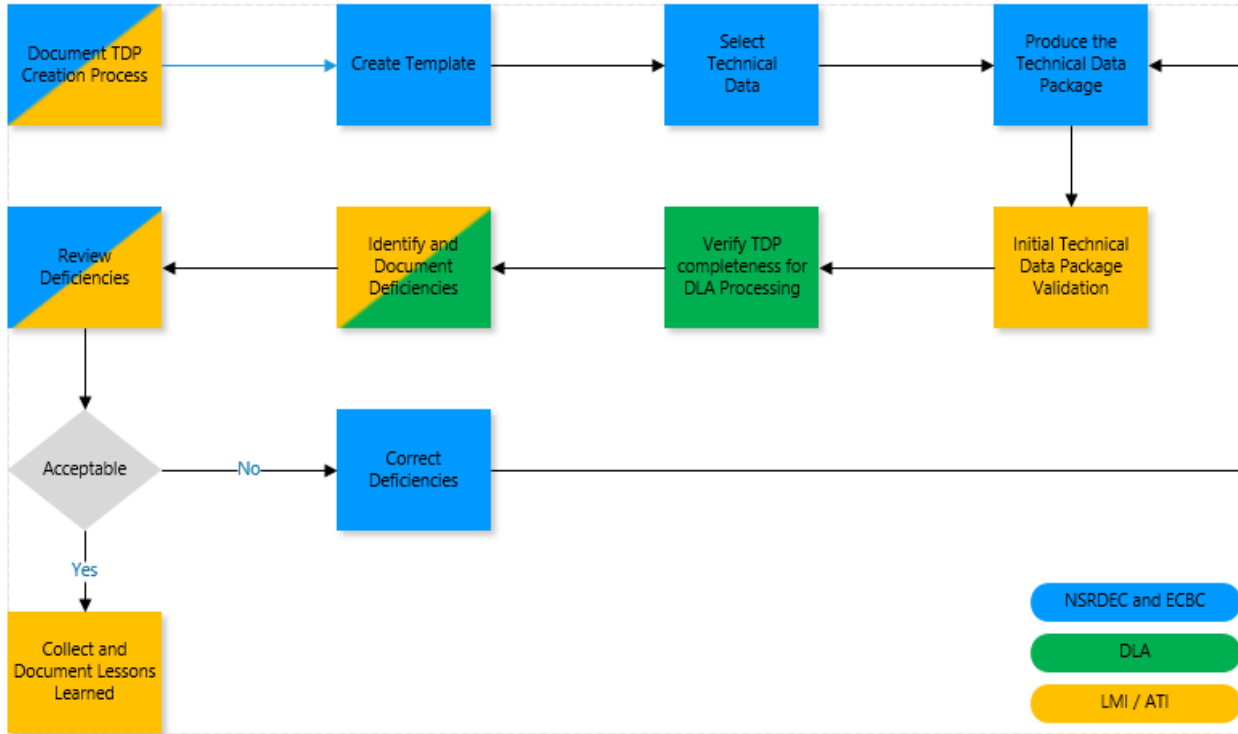
Schedule

The NSRDEC pilot ran from June 18, 2018 through January 8, 2019. LMI/ATI documented process and technology feedback throughout the project. Figure B-2 shows the NSRDEC pilot schedule.

Figure B-2. NSRDEC Pilot Schedule

ESA Technical Data Survey

At the beginning of the project, LMI/ATI issued surveys to potential pilot partners. LMI/ATI used the survey responses to create a shortlist of potential pilot partners and presented the list to DLA leadership during a go/no-go briefing. After DLA approved the pilot, LMI/ATI held a kickoff meeting with each partner. LMI/ATI maintained the survey responses, including the engagement survey and the responses received from NSRDEC, as shown in Table B-2.

Table B-2. NSRDEC Engagement Survey and Responses

1. Is your current technical data produced in a 3D format? If yes what CAD software package(s) do you currently use?
SOLIDWORKS is our 3D software package. We have some 3D data, with more moving forward.
2. If you do produce 3D models do you also produce associated 2D data?
Yes
3. If you are providing 2D-only technical data, are there any plans to adopt 3D technical data?
Yes
4. If you are using 3D technical data, are you annotating Product and Manufacturing Information (PMI) to the model you are creating, i.e. GD&T, surface finish, notes etc.?
Yes
5. Are there any programs/weapon systems under your authority for which only 3D technical data is currently available or will be available in the next 5 years? If yes, please identify the explicit program/weapon systems, when (month/year) they will enter the provisioning process (if applicable), and when they will begin seeking DLA support for sustainment.
None
6. Are there any programs/weapon systems under your authority for which legacy 2D data will be converted to 3D data and for which the ESA/PMO will no longer maintain and provide 2D data? If yes, please identify the explicit program/weapon systems and when (month/year) the transition will occur.
Eventually, but none at this moment.
7. What types of file formats make up your TDP package that supports each of your programs/weapon systems, i.e. native CAD, 3D PDF, JT, Excel, etc.?
DWG, DXF, Excel, Word, Gerber, Hex
8. Are there any programs/weapon systems under your authority that have adopted the use of 3D PDF for recording and distributing technical data? If yes, please identify the explicit program/weapon systems.
No
9. Is there any plan for programs/weapon systems under your authority to adopt 3D PDF for recording and distributing 3D technical data? If yes, please identify the explicit program/weapon systems that plan to do so.
Not yet
10. If you have programs/weapon systems that will not or cannot adopt a 3D PDF file format for technical data, have you given thought to what format you will use to provide technical data to DLA? If yes, please identify the specific file format(s) and explain your rationale for adopting that format.
11. Are you aware of the data elements that DLA requires in 2D or 3D technical data to support provisioning and procurement of weapon system parts?
2D—Yes, if there is additional information required in 3D PDF format we are unaware of those at this time.

12. Are you aware of the viewable/readable 3D formats that are acceptable by DLA for use in provisioning or sustainment?
No
13. Are you interested in learning more about the research DLA has completed as it relates to recording and distributing 3D technical data?
Yes

Candidate Parts List

For its pilot of SOLIDWORKS MBD software, NSRDEC generated a TDP for a Latch Assembly that bolts on to a Platform Extraction Bracket. The four piece parts selected for this pilot are summarized in the Table B-3.

Table B-3. Link Assembly Piece Parts

Drawing number	Nomenclature
11-1-1715	Latch Assembly
11-1-1717	Side Plate, Link
11-1-1718	Spacer, Link
11-1-3910	Bolt, Link

Pilot Summary

Based on our observations throughout the pilot and the feedback obtained from NSRDEC and the participating supply chain activities, our team gleaned several insights regarding NSRDEC's transition to a 3D TDP and the SOLIDWORKS MBD technology:

SOLIDWORKS MBD is a valid option for creating 3D PDF + STEP files that meet DLA's requirements for provisioning, cataloging, and sustainment. Representatives from each of the three supply chain activities involved in this pilot determined that the TDP created through SOLIDWORKS MBD met the requirements to support their respective functions. The representative from TACOM determined that the TDP that NSRDEC generated would have sufficiently supported the provisioning process. The cataloging activity at LIS had all of the information necessary to establish and assign an NSN. The representative from DLA Land & Maritime determined that the TDP contained all of the necessary information to support sustainment.

The representatives from the three supply chain activities noted some minor concerns with the output they reviewed. While some concerns related to clerical errors and style issues, others revealed that the SOLIDWORKS MBD technology is not as mature as Anark was at the end of prior DLA-LMI demonstrations. These concerns may be assuaged in the future as the software becomes more mature and as NSRDEC becomes more familiar with using SOLIDWORKS MBD to generate 3D PDFs.

There is value to be gained from including software providers and developers in the template creation process. During the pilot, our team learned that SOLIDWORKS MBD is not as mature as Anark, which was used in prior pilots. NSRDEC periodically

communicated with representatives from SOLIDWORKS to discuss problems and technology gaps. These communications will result in the creation of SRs and SPR. It is our team's understanding that the SRs and SPRs stemming from this pilot will go before a software development team for review and could influence the development schedule for the next version of SOLIDWORKS MBD.

Technical data templates do not need to be standardized to convey all of the information and technical data elements that DLA needs. The NSRDEC pilot began as a joint effort with ECBC. At the outset, our team recommended that the two sites develop a standardized, uniform template. LMI/ATI subsequently observed that the two sites instead chose to develop separate but similar templates. Total standardization was not achieved, but this did not have an impact on the project outcome. The lack of template standardization between the two ESAs appears to be driven by the fact that ECBC and NSRDEC are distinct business units that manage different parts under different schedules and with different operations. These differences lead to the development of similar templates that work well within their perspective business units.

The templates from both of the sites contained all of the necessary data elements to meet DLA's provisioning, cataloging, and sustainment needs (e.g., distribution statement, revision numbers, view states, dimensions, tolerances, etc.). Therefore, ESA/PMO template standardization is not necessary to support DLA's operations.

The actual input from participants is included below in the engagement survey, the summary from ECBC, the candidate parts list, the feedback from the supply chain activities, and the gap assessment.

Pilot Team Feedback

NSRDEC

At the end of the pilot, LMI/ATI requested a summary of the pilot from the perspective of our POCs at NSRDEC. The purpose of having this summary was to obtain technology and process insights from NSRDEC, to assess the overall feasibility of the technology tested, and to formulate lessons learned. The direct summary from our POCs at NSRDEC is provided below.

A handful of NSRDEC employees, including myself, attending SOLIDWORKS MBD training at Trimech. I spent time creating a template for a piece part and a template for an assembly. There were some struggles with the software. I did speak with our VAR and Oboe about these gaps in the software, I have not yet submitted formal SRs or SPRs, but I will be doing that very soon. More flexibility with tables is needed in MBD. The other major gap was the inaccurate representation of the template as you create it, and its final look once you've published you work. The blocks and text areas are not as shown in the template once you publish.

This was an excellent exercise and a lot was learned. This brought out deficiencies in our models that were not noticed when creating 2D drawings and gave me a better understanding of the upfront effort needed to have a smooth transition into the 3Di PDF via MBD.

NSRDEC is moving forward with the 3Di PDF format. The AirDrop Engineering Support Team will be converting their frequently used TDPs starting in March. ILSC really welcomed this format for their use in viewing TDPs, and I see the possibility of this being a successful format for some of the work that they do as well.

I genuinely appreciate all of the time and effort put forward by the LMI/ATI team. We would not be moving forward in this direction without them. Working in tandem with the folks at Rock Island was also very helpful and it was beneficial for us to learn from one another and bounce ideas back and forth.

Supply Chain Activity Feedback

Once developed, NSRDEC submitted its TDPs to the designated supply chain activities. In this pilot, the designated supply chain activities included TACOM, LIS, and DLA Land & Maritime. Each of the supply chain activities provided feedback on the ability of the TDPs support their respective duties. The actual feedback from the provisioning activity, the cataloging activity and the Supply Center is provided below.

Provisioning (TACOM)

- The 3D TDP format drawings were provided to our Equipment Specialists/ Provisioners in the TACOM ILSC at Natick Soldier Systems Center.

    - They didn't have any recommended changes. As long as the parts list was incorporated into the drawing format with the find numbers and detailed description of the items, that is all they require to process the NSN requests to the cataloging office in Battle Creek.

- As for the 3D illustrations, the most benefit we will gain using this format will be in the technical manual repair parts and special tools section where the complete assembly is shown in a disassembled state.

- As for sustainment, we don't have any recommended changes at this time.

Cataloging (LIS)

1. 11-1-1718 REV 2–Appears to have adequate characteristics to establish an NSN.

2. 11-1-3910 REV 2–Appears to have adequate characteristics to establish an NSN.

3. 11-1-1715–Appears to have adequate characteristics to establish an NSN.

4. 11-1-1717–Appears to have adequate characteristics to establish an NSN.

    a. The notes and/or revision blocks were still editable in these PDFs as well. Anyone other than the IP owner/design activity having the ability to edit any part of the data is a concern from our perspective. Need to have the ability for the data to be locked and certified as not being editable by anyone once it has been approved and released. This would include doing away with the ability for someone to insert text boxes, make red line marks through comments, or alter the drawing in any way after it has been approved and released.

      i. NSRDEC response: I will fix this, I completely agree they should not be editable.

b. Another item of concern from a cataloging perspective for these particular parts is whether or not a commercial or Military Specification already exists for them seeing as how they are bolts, screw, nuts, washers, etc. From a cataloging perspective and to maintain item entry control we would want to know the SPEC for the supply concept if one does indeed exist.

      i. NSRDEC response: This is not the case, the bolt is a unique item that needs to be manufactured. When possible, we always call out a spec for a hardware item.

c. Lastly, from a cataloging perspective things get very confusing and can be unclear when assemblies or piece part drawings (especially hardware) start referencing separate drawings for finish and surface treatments. Without having the definitive surface treatment clearly labeled on the drawing for the part being cataloged it may lead to NSNs being duplicates of existing items of supply or part numbers being associated with NSNs that do not represent the same supply concept. Often, the surface treatment for hardware items can be the only delineating factor in whether or not something is the same or different.

      i. LMI/ATI response: This info was attached to the PDF file. The cataloger did not realize this. Once he was told, he found the files that eliminate this issue. However, the issue is valid if the files are not attached or if the cataloger does not know to look for them.

Global Comments pertaining to 3D PDF drawings:

1. If the request for new NSN or the request for maintenance action on an existing NSN reflects something other than what is on the drawing or the cataloger does not have the skillset/training to extract characteristics data/part numbers from the drawing that could be an issue. Essentially, there is a learning curve to distinguish how the request submitted matches the drawing and how to pull out the characteristics based on the means of delivery, format of the 3D data, etc.

2. System-to-system compatibly, storage, and hardware capability to attach/process 3D PDF's with NSN requests is a matter of concern. Can the 3D PDFs be attached to ECAT requests or Federal Logistics Information Services Portfolio Workbench Provisioning Module/Federal Logistics Information Services Portfolio Workbench (FPW Prov Mod/FPW), records, etc? Can AMRDEC or another safe site/FTP site accommodate the size of a complete engineering data for provisioning (EDFP) package consisting of 3D PDFs or does another means need to be established to deliver them to support a provisioning effort and NSN assignment?

a. NSRDEC response: File size is an issue when we get into big assemblies, I'm not sure how to handle it at this moment. Considering that the file is a PDF I cannot imagine why it could not be attached just as easily as the current document type.

3. Source/vendor control nature of parts may need to be discussed as well, depending on what the standard for 3D PDF is going to be regarding piece parts of an assembly. RNCC/VC Coding on a LSA036 will indicate this and if the tech

data 3D PDF does not reflect the respective source/vendor control block with suggested/approved sources it may pose a problem cataloging the NSN.

    a. NSRDEC response: There is a separate title block for source/vendor control items; this procedure will not change.

Hope this info helps. Once again, the majority of my previous global comments apply to these as well. 3D data is only a piece of the puzzle and the standard by which it is read and transmitted and the way that cataloging requests are submitted against each piece of data will play a very large part in whether or not a 3D PDF is sufficient for cataloging purposes.

Supply Center (DLA Land & Maritime)

Drawing 11-1-1715:

- Didn't have any default tolerances in the title block and the dimension on the drawing had no unit label or tolerances. Not acceptable for Procurement purposes.

  - LMI/ATI response: I did advise the supply center that the units for dimension were listed in the default tolerance block, but the default tolerance block was missing as stated. I also advised that the dimension had no tolerance because it was a reference dimension. Was there a reason the default tolerances were not in the title box?

  - NSRDEC response: They should have been there, this was something I missed.

- Distribution Statement was present.

- Would have been nice to see all the components displayed in this one file.

  - NSRDEC response: (As in one drawing with assembly and piece parts defined?) The file size became very large, so this isn't something that could consistently be done. In this case it could have because this isn't a large assembly. I went back and forth on whether or not to do it.

- The date formats were European style, which was a bit confusing.

- Signatures were present.

- In the BOM you list the self-locking nut. It is a long note with a scroll. This might be better shown on 2 lines since the scroll option is hard to identify.

  - NSRDEC response: I will address this, I did not like how the BOM looked and will be fixing it so this scrolling issue doesn't occur.

- We noticed that in the model tree there is a reference to a 91847A436 Type 18-8 Stainless Steel Thin Hex Nut-1, 2 & 3. This is not shown on the BOM. Please explain the reference to this number.

  - NSRDEC response: 91847A436 is the McMaster car number for this nut, I downloaded the model from their website. In practice that number will be the defining spec and size, etc. My error in not renaming it.

Drawing 11-1-1717:

- Date formats were European style.

  - NSRDEC response: This is the date format we use on everything.

- Really tough to open the views.

- Distribution Statement was present.

- Signatures were present.

- Dimensions & tolerances readable.

Drawing 11-1-1718:

- Date formats were European style.

- Distribution Statement was present.

- Signatures were present.

- Dimensions & tolerances readable.

Drawing 11-1-3910:

- Date formats were European style.

- Distribution Statement was present.

- Signatures were present.

- Dimensions & tolerances readable.

Gap Assessment

In addition to soliciting supply chain activity feedback, LMI/ATI requested a gap assessment from NSRDEC. The purpose of the gap assessment was to document the user experience for the tested technology. Having a better understanding of the user experience, including issues and impacts on output, would allow LMI/ATI to make an informed assessment and recommendation regarding the feasibility of the SOLIDWORKS MBD software for DLA. The gap assessment provided by NSRDEC is included below:

- Tables

  - More flexibility with tables is needed in SOLIDWORKS MBD.

- Template Representation

  - Inaccurate representation of the template as you create it vs. its final look once you've published it.

Conclusions

Based on the documentation and results of the NSRDEC pilot, LMI/ATI drew the following conclusions:

1. ***SOLIDWORKS MBD is a valid option for creating 3D PDF + STEP files that meet DLA's requirements for provisioning, cataloging, and sustainment.***

Representatives from each of the three supply chain activities involved in this pilot determined that the TDP created through SOLIDWORKS MBD met the requirements to support their respective functions.

2. ***There is value to be gained from including software providers and developers in the template creation process.*** During the pilot, our team learned that SOLIDWORKS MBD is not as mature as Anark, which was used in prior pilots. NSRDEC periodically communicated with representatives from SOLIDWORKS to discuss problems and technology gaps. It is our team's understanding that the input stemming from this pilot will go before a software development team for review and, if possible, will influence the development schedule for the next version of SOLIDWORKS MBD.

3. ***Technical data templates do not need to be standardized to convey all of the information and technical data elements that DLA needs.*** The NSRDEC pilot began as a joint effort with ECBC. Our team subsequently observed, however, that the two sites were unable to develop a common template. The templates from both of the sites contained all of the necessary data elements to meet DLA's needs. Therefore, ESA/PMO template standardization is not necessary to support DLA's operations. Following standards and best practices when creating MBD models may make it easier to develop a consistent template.

Appendix C
Tank Automotive Research, Development and Engineering Center 3D PDF Pilot

Introduction

This pilot validated TARDEC's plan to convert its technical data from models in a native file format (PTC Creo) to a neutral file format (3D PDF + STEP) using the Tetra4D Enrich interpreter can meet DLA's provisioning, cataloging, and sustainment needs.

LMI/ATI opted to pilot with TARDEC because they had a high data availability and were using PTC Creo as their 3D CAD platform. Further, TARDEC already owned a Tetra4D license and had plans to generate 3D PDFs using this software. Since TARDEC had not yet developed a 3D PDF template, this pilot encouraged them to move forward with this development. Finally, LMI/ATI selected TARDEC for piloting because they demonstrated strong support a DLA pilot that would 1) validate the 3D PDF template and 2) explore the use of Tetra4D for producing 3D PDFs.

Roles and Responsibilities

Building, distributing, and validating a TDP required a series of steps and involvement from multiple stakeholders. The pilot team included representatives from TARDEC, supply chain activities, and R&D contractors. Table C-1 lists the stakeholders and their roles.

Table C-1. Pilot Team and Roles

Organization	Role
LMI/ATI	Facilitator
TACOM	Provisioning
LIS	Cataloging
DLA Land & Maritime	Supply Center
TARDEC	Data Provider

Figure C-1 illustrates the workflow and responsibilities for the TARDEC pilot. The R&D contractor team was comprised of representatives from LMI and ATI. LMI/ATI facilitated the pilot, documented the TDP creation process, identified and documented deficiencies, and collected and documented lessons learned.

Representatives from TARDEC were responsible for creating or updating 3D PDF templates, developing and validating the 3D PDF and STEP files for the selected assembly and piece parts, addressing deficiencies, and implementing recommended changes, as needed.

The supply chain activities, including TACOM, LIS, and DLA Land & Maritime were responsible for reviewing the TDP for provisioning, cataloging, and sustainment purposes. These activities were also responsible for determining TDP completeness and documenting any deficiencies. Finally, the supply chain representatives were responsible for sharing feedback with the pilot team.
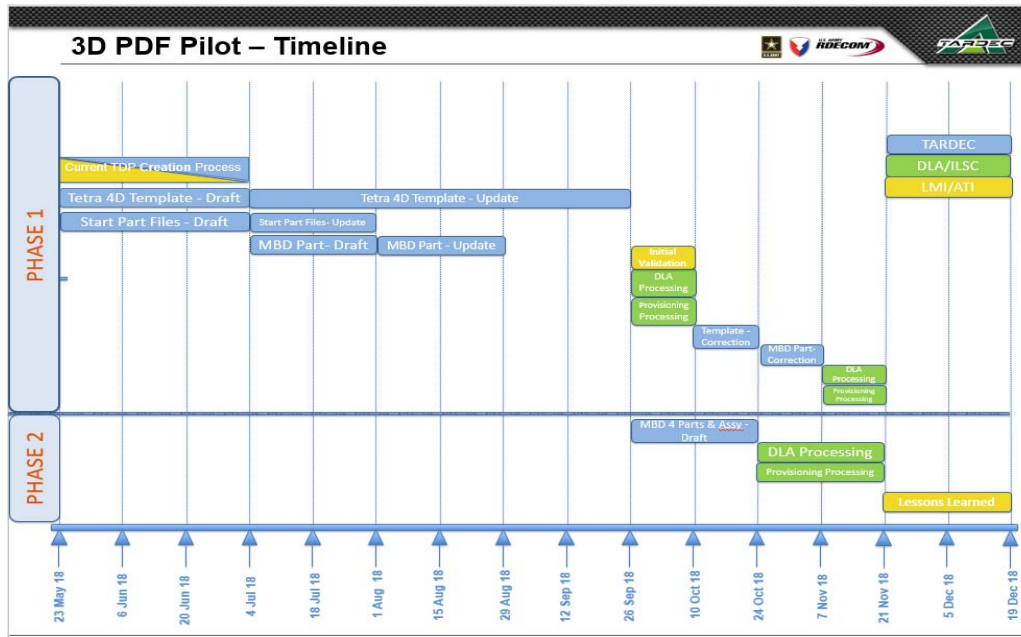
Figure C-1. TARDEC Pilot Process Workflow
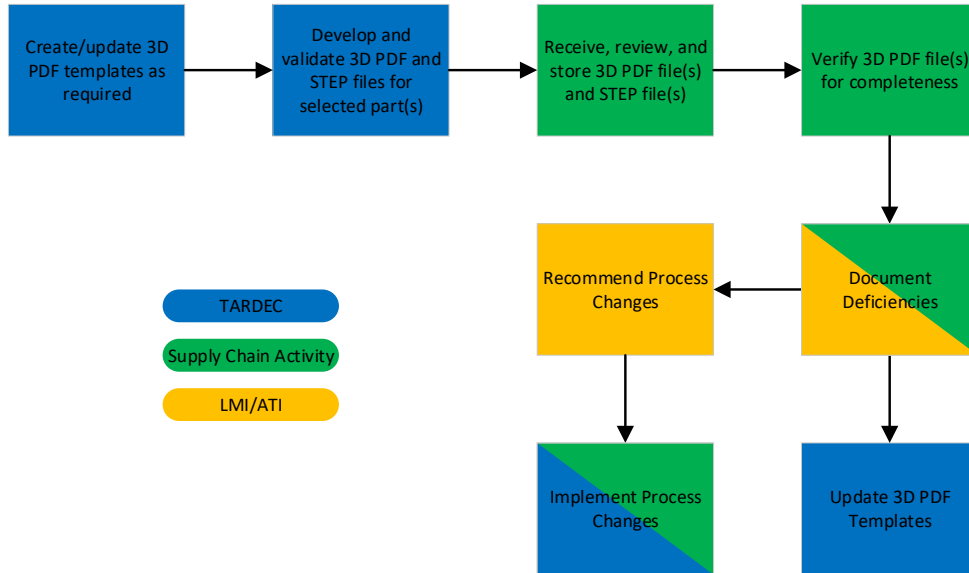
Schedule

The pilot with TARDEC ran from May 23, 2018 through December 19, 2018. LMI/ATI documented process and technology feedback throughout the project. See Figure C-2 for an expanded schedule.

Figure C-2. TARDEC Pilot Schedule

ESA Technical Data Survey

At the beginning of the project, LMI/ATI issued surveys to potential pilot partners. LMI/ATI used the survey responses to create a shortlist of potential pilot partners and presented the list to DLA leadership during a go/no-go briefing. After DLA approved the pilot, LMI/ATI held a kickoff meeting with each partner. LMI/ATI maintained the survey responses, including the engagement survey and the responses received from TARDEC, as shown in Table C-2.

Table C-2. TARDEC Engagement Survey and Responses

1. Is your current technical data produced in a 3D format? If yes what CAD software package(s) do you currently use?
Some across thousands of systems using multiple formats. I need a database that shows format and ownership rights across the many platforms we manage.
2. If you do produce 3D models do you also produce associated 2D data?
Not first-hand but yes
3. If you are providing 2D-only technical data, are there any plans to adopt 3D technical data?
Mostly talk
4. If you are using 3D technical data, are you annotating Product and Manufacturing Information (PMI) to the model you are creating, i.e. GD&T, surface finish, notes etc.?
Unsure?
5. Are there any programs/weapon systems under your authority for which only 3D technical data is currently available or will be available in the next 5 years? If yes, please identify the explicit program/weapon systems, when (month/year) they will enter the provisioning process (if applicable), and when they will begin seeking DLA support for sustainment.
I have no direct authority. I'm not aware of any.

Table C-2. TARDEC Engagement Survey and Responses

6. Are there any programs/weapon systems under your authority for which legacy 2D data will be converted to 3D data and for which the ESA/PMO will no longer maintain and provide 2D data? If yes, please identify the explicit program/weapon systems and when (month/year) the transition will occur.
I have no direct authority. I'm not aware of any.
7. What types of file formats make up your TDP package that supports each of your programs/weapon systems, i.e. native CAD, 3D PDF, JT, Excel, etc.?
Not sure, not an SME
8. Are there any programs/weapon systems under your authority that have adopted the use of 3D PDF for recording and distributing technical data? If yes, please identify the explicit program/weapon systems.
I have no direct authority. I'm not aware of any.
9. Is there any plan for programs/weapon systems under your authority to adopt 3D PDF for recording and distributing 3D technical data? If yes, please identify the explicit program/weapon systems that plan to do so.
I have no direct authority. I'm not aware of any.
10. If you have programs/weapon systems that will not or cannot adopt a 3D PDF file format for technical data, have you given thought to what format you will use to provide technical data to DLA? If yes, please identify the specific file format(s) and explain your rationale for adopting that format.
No
11. Are you aware of the data elements that DLA requires in 2D or 3D technical data to support provisioning and procurement of weapon system parts?
To some degree. You would do well to define the term provisioning, from my perspective the provisioning data is a responsibility of the program office executed by the ILSC.
12. Are you aware of the viewable/readable 3D formats that are acceptable by DLA for use in provisioning or sustainment?
3D PDF?
13. Are you interested in learning more about the research DLA has completed as it relates to recording and distributing 3D technical data?
Yes

Candidate Parts List

For its pilot of Tetra4D software, TARDEC generated a TDP for a "Test Weldment" assembly. The assembly and the three piece parts selected for this pilot are summarized in Table C-3.

Table C-3. DLA Test Weldment Assembly Piece Parts

Drawing number	Nomenclature
MBDTEST03	DLA Test Weldment (Assembly)
MBDTEST01	DLA Test Plate
MBDTEST04	Test Gusset
MDBTEST02	Test Boss

Pilot Summary

Based on our observations throughout the pilot and the feedback obtained from TARDEC and the participating supply chain activities, our team gleaned several insights regarding TARDEC's transition to a 3D TDP and the Tetra4D technology:

Tetra4D is a valid option for creating 3D PDF + STEP files that meet DLA's requirements for provisioning, cataloging, and sustainment. Representatives from each of the three supply chain activities involved in this pilot determined that the TDP created through Tetra4D met the requirements to support their respective functions. The representative for provisioning at TACOM noted that the TDPs appeared suitable, noting that it might be beneficial for TARDEC to include installation drawings, assembly drawings, vendor item control drawings, and source control drawings in their TDPs. The cataloging activity at LIS also noted that the TDPs contained "adequate characteristics to establish a [National Stock Number]." The representative from LIS made suggestions for improvement, such as including CAGE codes for the piece parts. The representative from LIS also noted concerns over the TDPs editability and implications for authoritative document sharing. Finally, the representative from the supply center noted that the TDPs were suitable for procurement with the exception of one PDF, which lacked some key notes and did not include individual views.

There is value to be gained from including software providers and developers in the template creation process. During the pilot, our team learned that Tetra4D is not a mature technology. TARDEC initiated biweekly and as-needed conference calls to improve its overall experience with Tetra4D. These communications resulted in deficiency reporting to the Tetra4D development team. The deficiencies that TARDEC reported may influence the development schedule for the next version of Tetra4D.

Technical data templates do not need to be standardized to convey all of the information and technical data elements that DLA needs. Prior to the pilot, TARDEC was provided several 3D PDF template examples from ARDEC Rock Island, Naval Air Systems Command (NAVAIR) Lakehurst, and Warner Robins Air Force base. LMI/ATI asked TARDEC to develop its TDP template based on the ARDEC examples. The template TARDEC developed was similar in look and feel to the sample templates. Our team observed that template standardization, although desired was not necessary. The TARDEC template contained all of the necessary data elements to meet DLA's needs. Following standards and best practices when creating MBD models may make it easier to develop a consistent template.

Pilot Team Feedback

TARDEC

At the end of the pilot, LMI/ATI requested a summary of the pilot from the perspective of our POCs at TARDEC. The purpose of having this summary was to obtain technology and process insights from TARDEC, to assess the overall feasibility of the technology tested, and to formulate lessons learned. The direct summary from our POCs at TARDEC is provided below.

One of TARDEC['s] 30-year strategies is supporting technical data modernization. TARDEC CAD design and validation teams joined the DLA 3D PDF Pilot to study the

feasibility of creating and processing 3D PDF files in place of 2D PDF drawings. What makes this pilot stand out from other 3D PDF DoD pilots is that this pilot experimented with utilizing Tetra 4D Enrich software in the creation of 3D PDF templates and files for the first time. Using this third-party software was advantageous since the software requires no programming experience and is less than $1,000 per license. This pilot offered the opportunity to create MBD models that adhere to standards and best practices. The final steps in this effort were to verify the 3D PDF template meets DLA standards. The team accomplished this by having DLA, approve provisioning and cataloging abilities by processing the 3D PDFs created in this pilot in place of 2D PDFs. At the completion of this effort, we insured that the 3D PDF template developed could be implemented on a large scale and that transitioning technical data from drawing centric to model centric is within reach.

Supply Chain Activity Feedback

Once developed, TARDEC submitted its TDPs to the designated supply chain activities. In this pilot, the designated supply chain activities included TACOM, LIS, and DLA Land & Maritime. Each of the supply chain activities provided feedback on the TDPs and stated whether or not the TDP as delivered would enable them to fulfil their respective duties. The actual feedback from the provisioning activity, the cataloging activity, and the Supply Center is provided below.

Provisioning (TACOM)

- The examples look good.

- I would still like to see examples of the following:

  - Installation Drawing

  - Assembly Drawing

  - Vendor Item Control Drawing

  - Source Control Drawing.

- In ASME Y14.24, they list many different types of drawings that would be nice to see examples of. However, it could take way too much time to create all of them for this project so the ones mentioned above are the ones that we would definitely want to see examples of.

Cataloging (LIS)

1. DLA Test Boss (MBDTEST02)–Appears to have adequate characteristics to establish an NSN.

2. DLA Test Weldment (MBDTEST03)–Appears to have adequate characteristics to establish an NSN.

   a. LIS response: But I suggest including the CAGEs for the piece parts that make up the weldment in the parts list. From a cataloging perspective we will not assume the down parts of the weldment have the same CAGE based on the CAGE for the assembly in the event only the weldment assembly drawing is being used to catalog all the down parts. I could see that being an option should the characteristics for all the piece parts be labeled on the one weldment drawing.

3. DLA Test Plate (MBDTEST01)–Appears to have adequate characteristics to establish an NSN.

4. DLA Test Gusset (MBDTEST04)–Appears to have adequate characteristics to establish an NSN.

5. One concern I have with all of these drawings as opposed to the other ones I have reviewed from you and ECBC is the fact that the notes containing characteristics, distribution statements, etc. are all editable by the person who views the drawings. How does that feature become locked after the final engineering approval to avoid them being changed? That's concerning from where we sit to ensure whatever the configuration of the part is at the time it is approved is what it remains until another revision is established by an engineer.

Global Comments pertaining to 3D PDF drawings:

1. If the request for new NSN or the request for maintenance action on an existing NSN reflects something other than what is on the drawing or the cataloger does not have the skillset/training to extract characteristics data/part numbers from the drawing that could be an issue. Essentially, there is a learning curve to distinguish how the request submitted matches the drawing and how to pull out the characteristics based on the means of delivery, format of the 3D data, etc.

2. I noticed there were parts lists within some of these drawings.

   a. LIS response: What were those CAGE Codes for those parts of the assembly? If an NSN is going to be established from a parts list does the request only reflect the drawing part number or will the expectation from a cataloging perspective be to drill down within the RNVV/VC (D/9) drawing reference on the request to try and locate the parts being cataloged. Data elements/how a request is submitted will affect whether or not this data is adequate.

3. System-to-system compatibly, storage, and hardware capability to attach/process 3D PDF's with NSN requests is a matter of concern as well. Can the 3D PDF's be attached to ECAT requests or FPW Prov Mod/FPW, records, etc?

   a. LIS response: Can AMRDEC or another safe site/FTP site accommodate the size of a complete EDFP package consisting of 3D PDFs or does another means need to be established to deliver them to support a provisioning effort and NSN assignment?

4. Source/vendor control nature of parts may need to be discussed as well depending on what the standard for 3D PDF is going to be regarding piece parts of an assembly. RNCC/VC Coding on a LSA036 will indicate this and if the tech data 3D PDF does not reflect the respective source/vendor control block with suggested/approved sources it may pose a problem for cataloging the NSN.

Hope this info helps. Ultimately, just looking at them [to see if] they could be used but from my perspective the 3D data is only a piece of the puzzle and the standard by which it is read, transmitted, and how cataloging requests are submitted against each piece of data will play a very large part in whether or not a 3D PDF is sufficient for cataloging purposes.

Supply Center (DLA Land & Maritime)

Test Plate—MBDTEST01:

- All good, suitable for procurement purposes.

Test Weldment—MBDTEST03:

- Land & Maritime response: Could not isolate individual views for the plate, gusset, and boss components. No notes were present for the components. Missing 2D dimensions for the gusset and boss. I spoke with the supply center and what is meant by this is they were expecting the 3 piece parts to be attached to this 3D PDF so if they sent out the Weldment for procurement the data would be all in one file. Not suitable for procurement.

Test Boss—MDBTEST02:

- Land & Maritime response: Surface datum B (I assume) was buried in the image. You can only see half of the letter. Otherwise, suitable for procurement.

Test Gusset—MBDTEST04:

- Land & Maritime response: Surface datum B (I assume) was buried in the image. You could see only half the letter. Otherwise, suitable for procurement.

Gap Assessment

In addition to soliciting supply chain activity feedback, LMI/ATI requested a gap assessment from TARDEC. The purpose of the gap assessment was to document the user experience for the tested technology. Having a better understanding of the user experience, including issues and impacts on output, would allow LMI/ATI to make an informed assessment and recommendation regarding the feasibility of the Tetra4D software for use to create 3D PDFs. The gap assessment provided by TARDEC is included below:

1. Unable to import annotations in text cells.

2. Unable to import system's parameters in text cells.

3. Unable to view solid welds in weldment combined views. (Welds can be viewed, but they cannot be viewed as a solid; they must be viewed as a light weight weld in order to translate into Tetra correctly. The weld option is selected within Creo.)

4. No print option to print selected views.

5. Annotations and GD&T do not appear in Tetra in the same orientation and location as in the native CAD.

Lessons Learned from TARDEC

LMI/ATI further requested a set of lessons learned from TARDEC to inform final recommendations related to the Tetra4D technology as well as the feasibility of using 3D PDF for DLA's supply chain purposes. The lessons learned that TARDEC provided are below:

1. It is important to follow standards and best practices closely while creating MBD models to produce a stable representation that could be exported to 3D PDF

successfully every time regardless of who is the modeler. The fact that it easy to update Enrich templates will make this issue less problematic.

2. It is important to share the 3D PDF files with the widest circles of users to get them familiar with the new format and to gauge their experience.

3. The next step is to find a small program that can partially utilize MBD and 3D PDF technologies.

4. If the software POC is available and known, provide feedback often to the software developer as they may fix issues identified in future software releases.

5. Setup software training early on in the project for entire project team.

6. Setup the ability to ask questions with the software vender to avoid delays throughout the project.

Conclusions

Based on the documentation and results of the TARDEC pilot, LMI/ATI drew the following conclusions:

1. ***Tetra4D is a valid option for creating 3D PDF + STEP files that meet DLA's requirements for provisioning, cataloging, and sustainment***. Representatives from each of the three supply chain activities involved in this pilot determined that the TDP created through Tetra4D met the requirements to support their respective functions.

2. **There is value to be gained from including software providers and developers in the template creation process.** During the pilot, our team learned that Tetra4D is not a mature technology. TARDEC initiated biweekly calls and as-needed conference calls with developers to enhance their overall experience with Tetra4D. These communications resulted in deficiency reporting to the Tetra4D development team. The deficiencies that TARDEC identified may influence the development schedule for the next version of Tetra4D.

3. ***Standardization of technical data templates is not necessary in order to convey all of the information and technical data elements that DLA needs***. Prior to the pilot TARDEC was provided several 3D PDF template examples from ARDEC Rock Island, NAVAIR Lakehurst, and Warner Robins Air Force base. They were asked to develop their template based on the ARDEC examples. The template TARDEC developed had a similar look and feel to the sample templates. Our team observed that template standardization, although desired, was not necessary. The TARDEC template contained all of the necessary data elements to meet DLA's needs. Following standards and best practices when creating MBD models may make it easier to develop a consistent template.

Appendix D
A-10 Program Pilot

Introduction

This pilot evaluated whether the existing processes for technical data file creation, distribution, and use within the A-10 Thunderbolt II Wing Replacement Program Office at the Ogden Air Logistics Complex at Hill AFB in Utah meet DLA's sustainment needs. LMI/ATI further aimed to determine whether the TDP development and distribution processes between the A-10 Program Office and the DLA Aviation in Richmond, VA, are replicable across other DLA supply centers. To this end, LMI/ATI captured the steps that the engineering personnel at the A-10 Program Office take to create and share 3D PDF + STEP/IGES technical data files with DLA Aviation.

The A-10 Program Office and DLA Aviation have been using 3D PDFs for over 4 years to support the Enhanced Wing Assembly (EWA) for the A-10 aircraft. LMI/ATI collaborated with the A-10 Program as their office is already using 3D PDF + STEP/IGES for their TDPs.

Unlike the other pilots conducted during the first half of this project, the pilot with the A-10 Program Office was a partial-scope pilot. The A-10 Program currently uses 3D PDF + STEP for their TDPs. Our team determined that the existing A-10 engineering template could be used for this pilot and that it was unnecessary to collect pilot summaries and gap assessments from our A-10 partners. Another key difference in the A-10 pilot was that there was no review or feedback from DLA provisioning or cataloging; the pilot only entailed feedback and process capture from DLA Aviation.

LMI/ATI's study of the A-10 Program and DLA Aviation TDP processes consisted of four conference calls and one in-person meeting at DLA Aviation in Richmond (A-10 Program representatives joined via phone).

Roles and Responsibilities

Figure D-1 illustrates the workflow and responsibilities for the A-10 Program pilot. The R&D contractor team was comprised of representatives from LMI and ATI. LMI/ATI facilitated the pilot, documented processes regarding 3D PDF creation, distribution, and use, coordinated meetings, and analyzed the results of the pilot.

Within the workflow, the representatives from the A-10 Program at Hill AFB were responsible for briefing LMI/ATI on their processes for creating and distributing 3D PDFs. They were also responsible for selecting the technical data for the study and for providing feedback on LMI/ATI's process capture.

Finally, DLA Aviation was responsible for briefing LMI/ATI on its processes for receiving, storing, and using 3D PDFs. They were also responsible for providing feedback to LMI/ATI on these activities, documenting any deficiencies, and sharing their feedback with the rest of the pilot team.

Figure D-1. A-10 Program Pilot Process Workflow
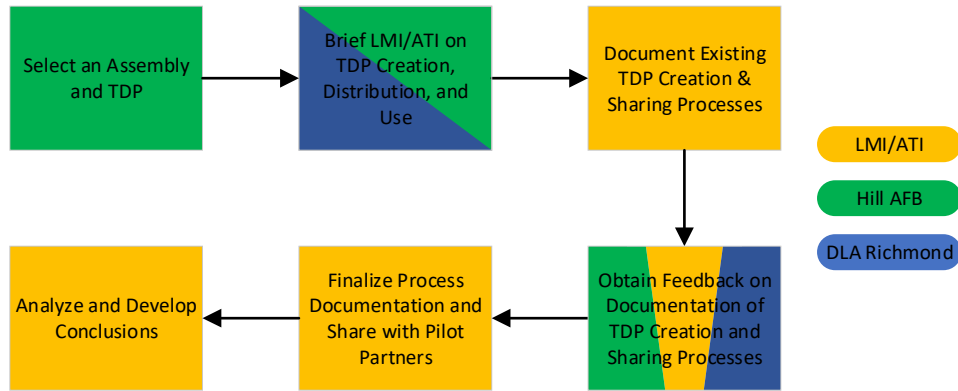
Building, distributing, and validating a TDP required a series of steps and involvement from multiple stakeholders. The pilot team included representatives from the A-10 Program Office, DLA Aviation, and R&D contractors from LMI & ATI. Table D-1 lists the stakeholders and their roles.

Table D-1. Pilot Team and Roles

Organization	Role
LMI/ATI	Facilitator
A-10 Program Office	Data Provider
DLA Aviation	Supply Center

Schedule

The pilot with the A-10 Program Office at Hill AFB ran from September 11, 2018 through November 14, 2018. LMI/ATI documented process and technology feedback throughout the project. Figure D-2 shows the A-10 Program pilot schedule.

Figure D-2. A-10 Program Pilot Schedule
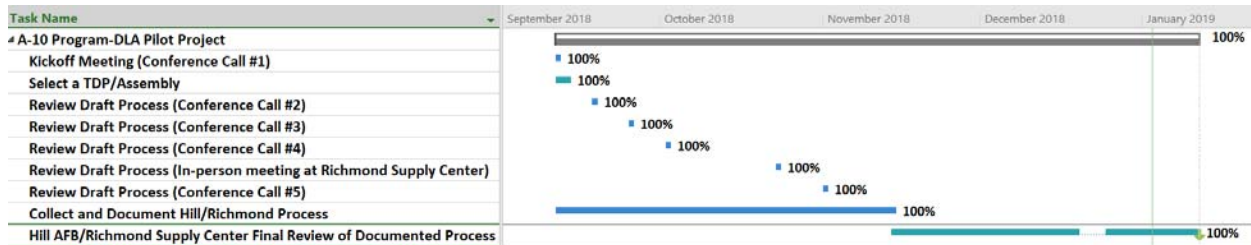
Summary

Based on our observations throughout the pilot as well as the feedback obtained from the A-10 Program Office and DLA Aviation, our team gleaned several insights regarding DLA's transition to 3D PDF and the MBD SOLIDWORKS technology.

The process meets DLA's needs. Our team observed that the process for creating and distributing TDPs at A-10 Program Office and DLA Aviation meets DLA's needs for supply chain support. The A-10 Program Office is able to generate 3D PDF TDPs and DLA Aviation is able to receive and process TDPs from the A-10 Office. Additionally, our team determined that the process we documented between the A-10 Program and DLA Aviation could be replicated across other ESAs and DLA Supply Centers, especially given their use of Anark products—a well-known tool for converting and presenting data.

Process should be formalized to reduce risk. The process as observed had limited documentation and relied in many cases on long-established personal relationships. Email and/or secure file sharing through AMRDEC SAFE was utilized to move data between stakeholders. As part of this pilot process the team fully documented all information flows and provided these to all stakeholders, providing back-up documentation should a sudden stakeholder change occur. We recommend that DLA and/or the A-10 Program Office use this documentation to create a job aid or other document formalizing the process steps to ensure continuity and reduce risk in the long term.

The output from the A-10 Program Office and DLA Aviation differs slightly from other pilots. The 3D PDF output from the A-10 program differs slightly from that of other pilots in terms of presentation. The A-10 Program's TDPs contain all of the critical information that a TDP should contain (i.e., tolerancing, distribution statements, view-states, a notes section, etc.). However, the pertinent technical information in an A-10 Technical Part Report is presented differently. One of the most noticeable differences between the TDPs seen from the A-10 Office and the other TDPs is the length of the document: the A-10 Program's Technical Part Report is a multi-page report whereas other TDPs have typically been one or two-page documents.

Candidate Parts List

To support documentation of the A-10 Program Office's processes for creating, distributing, and using TDPs, the representatives from the A-10 program selected a TDP for the Wedge Assembly.Table D-2 lists the Enhanced Wing Assembly Piece Part.

Table D-2. Enhanced Wing Assembly Piece Part

Part Number	Nomenclature
162D612512-1003C	Wedge Assembly, Trailing Edge, Outer Wing, LH

As this was a partial-scope pilot, LMI/ATI only sought input from one DLA activity: DLA Aviation. The representative from DLA Aviation was responsible for briefing LMI/ATI on how the A-10 Program's TDP processes met their procurement and sustainment needs.

Findings

This section includes the summary of the process for creating, distributing, and using a TDP within the A-10 Program Office and the DLA Aviation. LMI/ATI developed this process capture based on briefs that the representatives from the A-10 Program Office and DLA Aviation provided. LMI/ATI finallized this summary in collaboration with the pilot

partners. The summary below (also summarized in Figure D-3) is divdied into two parts to reflect the distinct processes at each of the two sites involved in this pilot.

Figure D-3. A-10 Program Processes for TDP Creation, Distribution, and Use
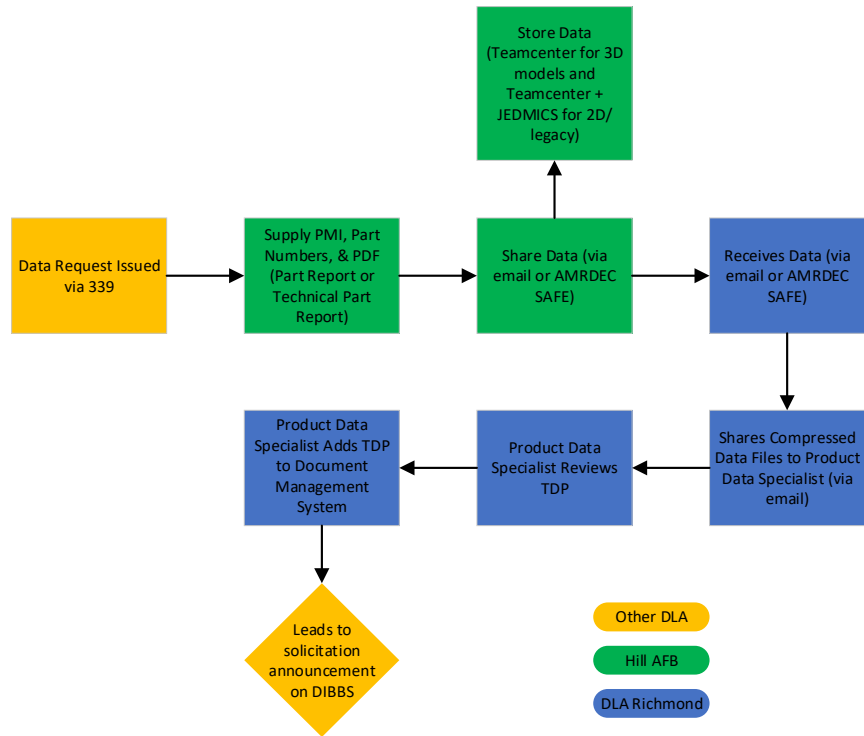
Note: DIBBS = DLA Internet Bid Board System.

Process Capture Part 1: A-10 Program Office

The Ogden Air Logistics Center at the Hill AFB assembled a TDP for an Enhanced Wing Assembly for the A-10 aircraft. The A-10 Program Office currently uses the Teamcenter Product Life Cycle Management Software from Siemens to manage its technical data. Specifically, the A-10 Program Office uses Teamcenter to create and manage technical data for 2D drawings and 3D models. The A-10 Program Office sends copies of its 2D drawings and Engineering Change Orders to the Joint Engineering Data Management Information and Control System (JEDMICS). Broadly, the A-10 Program Office's process for submitting a TDP from a service PMO to DLA Aviation is as follows:

1. DLA issues a data request to the Commodities Department within the A-10 Program Office via a screening analysis request using the 339 process.

2. The A-10 Program Office supplies part numbers required for requested assembly data.

   a. The A-10 Program Office supplies part numbers that start with the number 162 to produce the new Enhanced Wing for the A-10 aircraft.

3. The A-10 Program Office supplies and uses relevant PMI.

   a. In the case of the Enhanced Wing Assembly for the A-10 aircraft, the A-10 Program Office used a limited amount of PMI to create its 3D models. It

mostly used GD&T information to find key information such as hole locations, surface profile tolerances, hole positioning tolerances, etc.

4. The A-10 Program Office supplies a PDF, either in the form of a Part Report or a Technical Part Report (See Figure D-4 for Technical Part Report Example).

   a. The Part Report and the Technical Part Report both provide title block information, notes, specifications, materials, processes, revision information, and parts lists in text format.

   b. The Technical Part Report differs in that it has 3D data embedded in the report PDF.

Figure D-4. Sample Technical Part Report
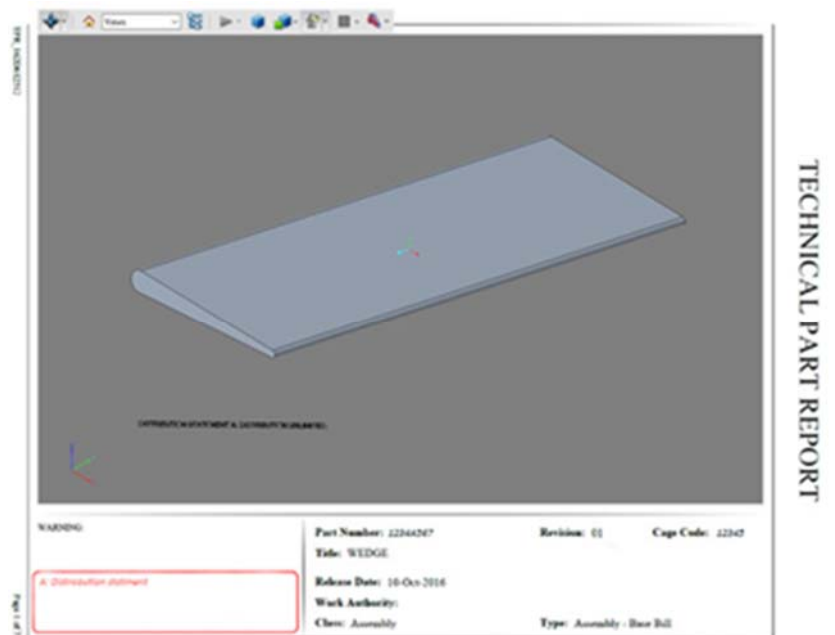
   c. The A-10 Program Office may or may not have 3D PDFs available for all models and assemblies. The 3D PDF (Technical Part Report), if available, will be the preferred file type. Otherwise, the A-10 Program Office will send the Part Report.

5. For the Enhanced Wing Assembly, which includes a 3D model, Engineering stores the files in Teamcenter at A-10 Program Office: For a DLA procurement request Hill AFB will extract the data shown in Figure D-5 for the Enhanced Wing Assembly:

Figure D-5. Files Stored for EWA

162d612512-1003c-01-fas.csv
162d612512-1003c-01-sdsup.igs
162d612512-1003c-01-sdsup.stp
PR_162D612512-1003C_01.pdf
TPR_162D612512-1003C_01.pdf

6. For Legacy Data with 2D drawings & Parts Lists, Engineering stores the files in Teamcenter and Data Management stores the files in JEDMICS within the A-10 Program Office. DLA obtains the files from JEDMICS.

7. The A-10 Program Office will extract the data shown in Figure D-6 when DLA issues a procurement request for legacy 2D data.

Figure D-6. Files Extracted for EWA Procurement Request

160D612512.pdf
160D612512-1.igs
160D612512-1.stp
PL160D612512.pdf
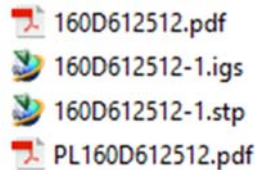
8. The A-10 Program Office submits the files to DLA Aviation.

Process Capture Part 2: DLA Aviation

When the A-10 Program Office submits a TDP to a DLA Aviation, it prompts a series of actions within DLA; these actions are outlined below. It is important to note that the procedures described below apply to both the 160 (legacy wing parts) and 162 (enhanced wing parts); the 162 parts may contain a few or many of the Parts Reports or Technical Parts Reports, but they are handled the same. Generally, these PDF documents are not zipped but included alongside the models to the Product Data Specialist. The steps involved for processing a TDP at DLA Aviation as follows:

1. Receive

   a. Typically, the A-10 Program Office Engineering will send the Enhanced Wing Assembly TDP to Product Data Management Division at DLA Aviation via email. The file types below comprise that TDP.

      TPR_162D611701-2053_03.PDF
      162D611701-2053_03-sdsup.igs
      162D611701-2053_03-sdsup.stp

   b. Legacy data is sent in the same fashion and includes the file types listed below.

      160D217008-587.igs
      160D217008-587.stp

   c. If the TDP is too large to send via email, then DLA Aviation receives the TDP through AMRDEC SAFE.

2. Process

   a. For easier handling within the DLA repository, DLA Aviation Engineering will compress the Enhanced Wing Assembly model files (STEP and IGES) into a zip file, such as:

      162D611701-2053_03-sdsup.zip

   b. Legacy data is handled in the same fashion and includes the file type shown below:

160D217008-587.zip

 c. DLA Aviation Engineering sends the compressed version of the Enhanced Wing Assembly TDP via email to the Product Data Specialist who requested the model. The files sent are shown below:

TPR_162D611701-2053_03.PDF
162D611701-2053_03-sdsup.zip

 d. Legacy data is handled in the same fashion and includes the file type shown below:

160D217008-587.zip

3. Store

 a. The Product Data Specialist reviews the TDP.

 b. The Product Data Specialist adds the TDP into the Document Management System, along with other bidset data. See Figure D-7.

Figure D-7. Product Data Specialist Adds TDP to Document Management System

Drawings: Rows Returned = 13

Drawing Number	CageCd	DocDataCd	DocRev	ActVrs	RevDt	No of Imgs	NbrSheets	Rights	LicAgrmt	DistStmt	Expc
162D611701-2053	98747	RE	03		11/18/2010	1	1	U		D	Y
162S900705	98747	SS	F		08/17/2011	1	1	U		D	Y
162S900711	98747	SS			06/09/2010	1	1	U		D	Y
201308307	98747	CN	A		09/10/2015	1	1	U		D	Y
201308307	98747	RE	A		09/09/2015	1	1	U		D	Y
P-F501	77751	AT	B2		09/24/1997	1	1	U		D	Y
P-F501	77751	CN	B		08/22/2011	1	1	U		D	Y
P-F501	77751	SS	B		03/06/1997	1	1	U		D	Y
P-M501	77751	AT	H2		09/24/1997	1	1	U		D	Y
P-M501	77751	CN	H		11/02/1979	1	1	U		D	Y
P-M501	77751	SS	H		01/20/2014	1	1	U		D	Y
Z-R701	77751	AT	C1		02/10/1998	1	1	U		D	Y
Z-R701	77751	SS	C		02/10/1998	1	1	U		D	Y

4. Distribute

 a. TDP storage and release in the Document Management System leads to the solicitation announcement on DIBBS.

 b. When the solicitation is in DIBBS, the contractor can retrieve this information from cFolders and download it.

Conclusions

Based on the documentation and results of the A-10 pilot, LMI/ATI developed the following conclusions:

1. ***The process meets DLA's needs***. Our team observed that the process for creating and distributing technical data packages at A-10 Program Office and DLA Aviation meets DLA's needs for supply chain support. DLA Aviation is able to receive information from the A-10 Program Office and process that information to fulfil their responsibilities.

2. **The process should be formalized to reduce risk**. The process as observed had limited documentation and relied in many cases on long-established

personal relationships. Email and secure file sharing through AMRDEC SAFE was utilized to move data between stakeholders. As part of this pilot process, the team fully documented all information flows and provided these to all stakeholders, providing back-up documentation should a sudden stakeholder change occur. We recommend that DLA and the A-10 Program Office use this documentation to create a job aid or other document formalizing the process steps to ensure continuity and reduce risk in the long term.

3. ***The output from the A-10 Program Office and DLA Aviation Hill AFB differs slightly from other pilots***. The 3D PDF output from the A-10 program differs slightly from that of other pilots in terms of presentation. The A-10 Program's TDPs contain all of the critical information that a TDP should contain (i.e., tolerancing, distribution statements, view-states, a notes section, etc.). However, the pertinent technical information in A-10 Technical Part Report is presented differently.

Appendix E
Naval Surface Warfare Center Philadelphia Division JT Pilot

Introduction

This pilot evaluated whether the JT2Go viewer can provide NSWCPD adequate capability to integrate the JT+PDF TDPs. The pilot demonstrated that the free version of the software, JT2Go, supports DLA's provisioning, cataloging, and sustainment needs.

LMI/ATI opted to pilot with NSWCPD due to the availability of their technical data, which they receive directly from the shipbuilder, EB. Further, LMI/ATI selected NSWCPD because they demonstrated strong support for a DLA pilot that would validate and test the feasibility of using the JT2Go viewer for use in downstream processes.

Roles and Responsibilities

Building, distributing, and validating a TDP required a series of steps and involvement from multiple stakeholders. The pilot team included representatives from NSWCPD, supply chain activities, and R&D contractors. Table E-1 lists the stakeholders and their roles.

Table E-1. Pilot Team and Roles

Organization	Role
LMI/ATI	Facilitator
U.S. Naval Supply Systems Command (NAVSUP)	Provisioning
LIS	Cataloging
DLA Land & Maritime	Supply Center
NSWCPD	Technical Support Activity
EB	Data Supplier/OEM
Siemens	Software Provider

Figure E-1 illustrates the key stakeholders and relationships that comprise the NSWCPD pilot.

Figure E-1. 3D TDP Pilot Team
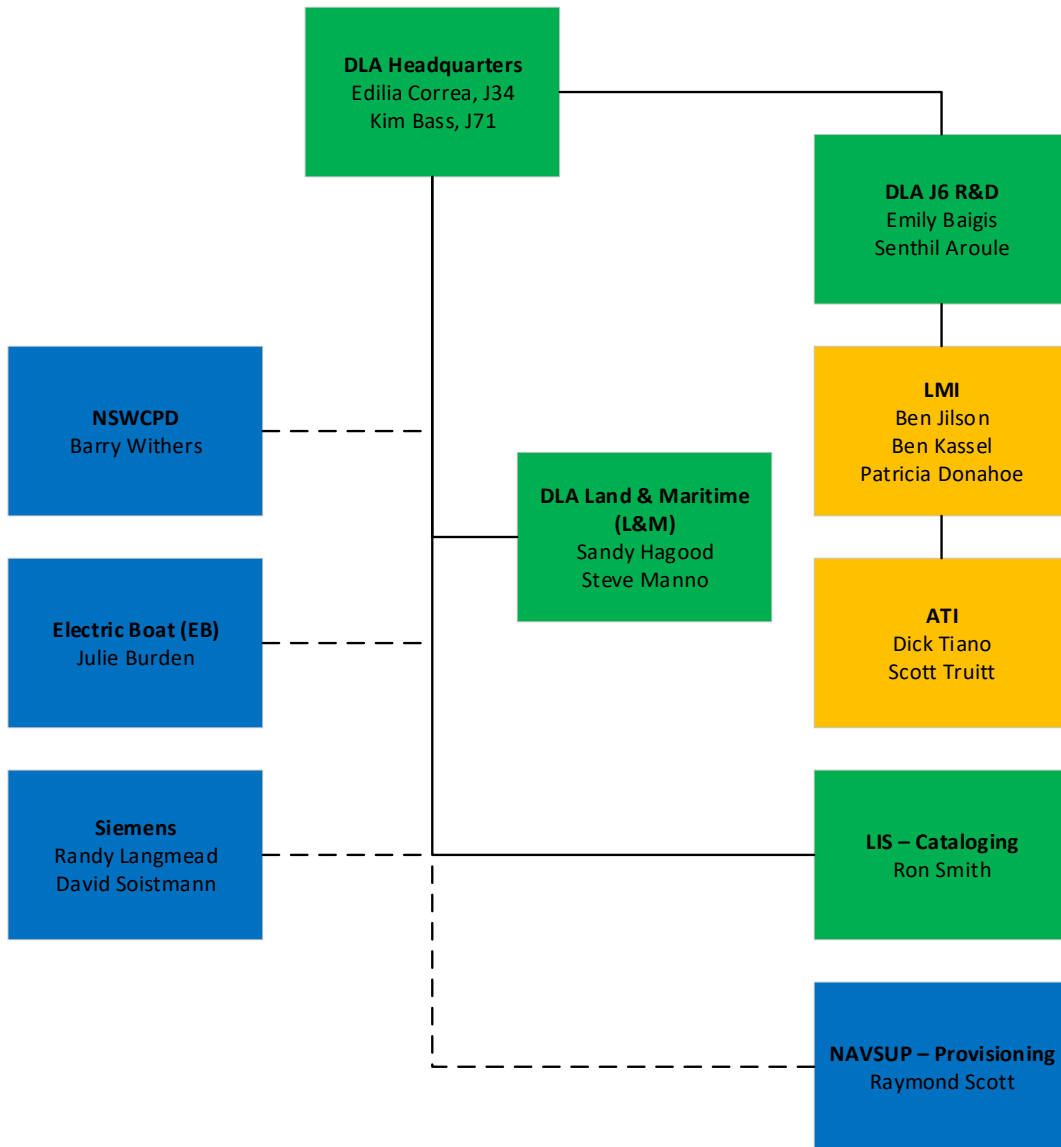
Figure E-2 illustrates the pilot workflow. The R&D contractor team was comprised of representatives from LMI and ATI. LMI/ATI facilitated the pilot, documented the TDP creation process, identified and documented deficiencies, and collected and documented lessons learned. Representatives from NSWCPD were responsible for providing the technical data created in JT format by EB. The supply chain activities, including U.S. NAVSUP, LIS, and DLA Land & Maritime were responsible for reviewing the TDP for provisioning, cataloging, and sustainment purposes. These activities were further tasked with determining TDP completeness and documenting deficiencies. Finally, the supply chain representatives were responsible for sharing feedback with the pilot team.

EB created and supplied the JT+PDF technical data to NSWCPD. Siemens provided technical support for the NX CAD software, the viewer, and the Teamcenter product lifecycle management (PLM) system.

Figure E-2. 3D TDP Pilot Workflow and Responsible Organizations
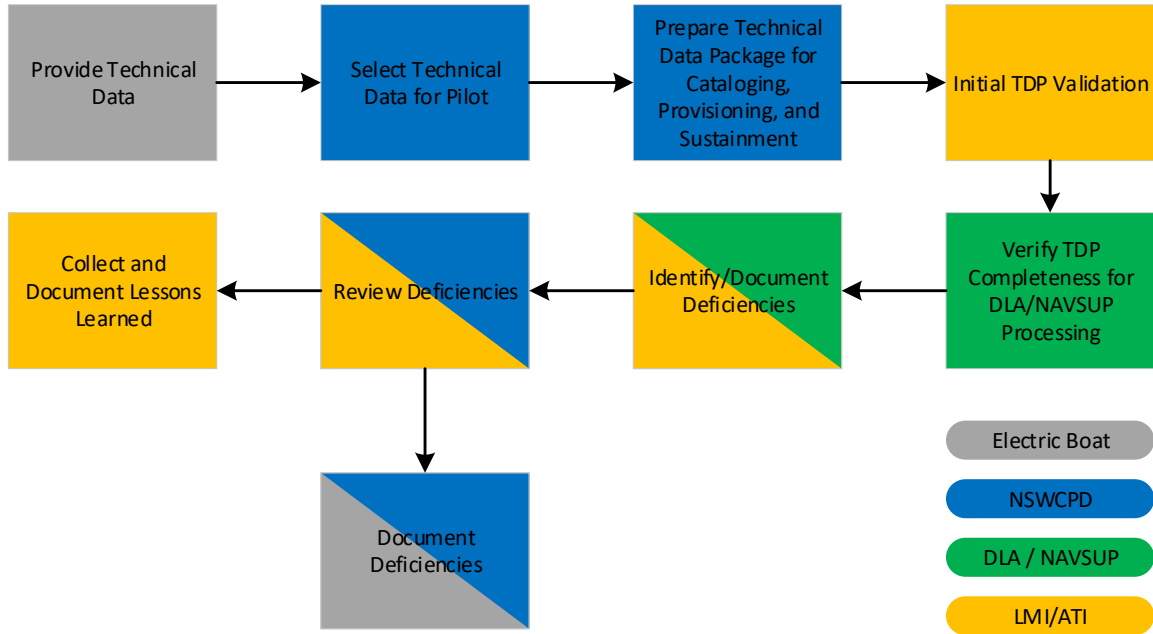
Schedule

The pilot with NSWCPD ran from August 3, 2018 through June 14, 2019. LMI/ATI documented process and technology feedback throughout the project. See Figure E-3 for an expanded schedule.

Figure E-3. NSWCPD Pilot Schedule

Task Name	Duration	Start	Finish
◢ NSWCPD DLA Pilot Project	258 days	Mon 6/4/18	Wed 5/29/19
▷ Document Technical Data Flow Process	20 days	Mon 6/11/18	Fri 7/6/18
▷ Obtain JT2GO Viewer	154 days	Wed 6/6/18	Mon 1/7/19
▷ Meetings at NSWC	183 days	Fri 8/3/18	Tue 4/16/19
▷ Obtain initial technical data from Electric Boat	145 days	Mon 6/4/18	Fri 12/21/18
▷ Obtain Technical Data from Electric Boat	96 days	Mon 6/25/18	Mon 11/5/18
▷ Prepare Technical Data Package for Cataloging/Provisioning/Sustainment	29 days	Thu 10/25/18	Tue 12/4/18
▷ Notify NAVSUP for provisioning	34 days	Wed 12/5/18	Mon 1/21/19
▷ LIS to retrieve technical data package	19 days	Tue 1/22/19	Fri 2/15/19
▷ DLA Supply Center	58 days	Mon 2/18/19	Wed 5/8/19
▷ Identify/Document Deficiencies	116 days	Wed 12/5/18	Wed 5/15/19
▷ Correct Deficiencies if Required	5 days	Thu 5/16/19	Wed 5/22/19
▷ Collect and Document Lessons Learned	123 days	Mon 12/10/18	Wed 5/29/19

NSWCPD's Electronic Data for Provisioning (EDFP) Process Flows

Original Electronic Data for Provisioning Process Flow

The original process workflow for EDFP is shown in Figure E-4. The workflow was developed to show the entities involved and how the EDFP process flows between each. This high-level workflow is intended to illustrate process flow only. The detailed definition of the workflow is described below.

- The electronic data for provisioning process starts when the shipbuilder notifies the Technical Solution Authority (TSA) of the development and readiness of the provisioning package Interactive Computer-Aided Provisioning System (ICAPS) and EDFP.

- The TSA reviews the EDFP and adjudicates the ICAPS package. When ready, the TSA enters the EDFP in the JEDMIS repository NSEDR and notifies NAVSUP Weapon Systems Support (WSS) that the ICAPS package is ready and that the EDFP is available in NSEDR.

- NAVSUP WSS downloads the EDFP, reviews and adjudicates the ICAPS package, and adds coding to it.

- When completed WSS releases the data and submits the appropriate supply support requests (SSRs) to Defense Logistics Information Service (DLIS) for cataloging. At this point DLIS will download the EDFP and adjudicate and catalog the NSNs.

The last two phases of EDFP flow are independent of the Provisioning process. Once it has received a Military Standard Requisitioning and Issue Procedures requisition, DLA will download the EDFP from NSEDR for procurement purposes. In the event of bidding, and to develop a proposal, any vendors have to access the EDFP from NSEDR systems.

Figure E-4. Original EDFP Process Workflow
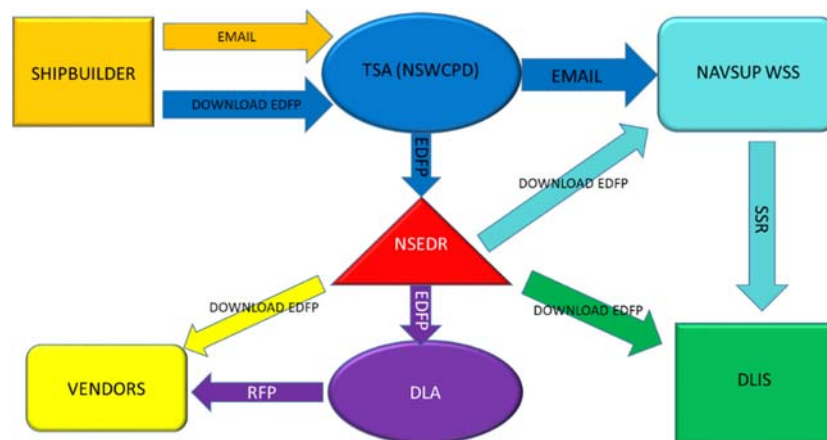
## New Provisioning Technical Data Process

The new provisioning process workflow for EDFP is shown in Figure E-5. The workflow was developed to show the entities involved and the detail actions that happen within their swim lanes. The new process flow provides a much clearer picture of the provisioning technical data process. The detailed definition of the workflow is described below.

Note that the acronyms for the workflow are listed in Appendix I.

- EB engineering/materials group selects and procures the components required to support the new configuration.

- Information is sent to EB's logistics group, who obtains and evaluates the technical data. The logistics group also develop the ICAPS file.

- The ICAPS file is sent to the engineering/materials group to so they can review the provisioning technical documentation.

- The logistics group submits the ICAPs file to TSA and adjudicate comments.

- TSA performs a technical review, forwards to Cognizant ISEA/TWH, provide comments and code the ICAPS file.

- TSA decision points include:

  - Return to EB logistics

  - Submit to DLA-LIS for review and correct if necessary or

  - Release to NAVSUP WSS for processing.

- WSS will assign allowance parts list (APL) if necessary, review technical documentation/enterprise resource planning (ERP)/Web FLIS data for existing material, resolve unforeseen circumstances with TSA, process ICAPs project, document new packaging and preservation requirements (if necessary) and release file to Navy ERP, master allowance parts list, and Configuration Data Managers Database-Open Architecture.

- WSS systematic output to DLA-LIS via Navy ERP processing for new item establishment or support on existing National Item Identification Numbers (NIINs) (Supply Support Request SSR/Logistics Document LDOC) and/or manual requests as necessary (i.e., supporting documentation not available in NSEDR (quotes/catalog pages, etc.) to DLA or General Services Administration library and electronic cataloging request to include inter-service managed repairable assets.

- TSA conducts a quality assurance review of WSS output, resolves data discrepancies with WSS, and Notifies EB of completion.

- EB is notified.

- EB adds the APL to configuration status accounting record.

Figure E-5. New Provisioning Technical Data Process
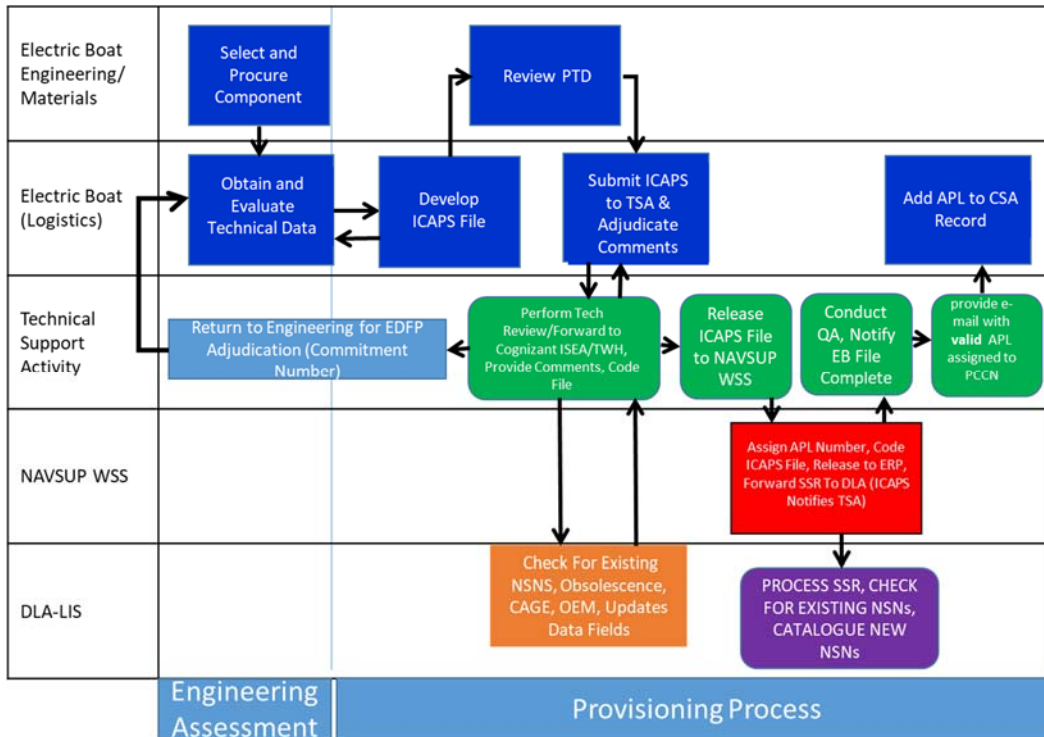
ESA Technical Data Survey

The survey included in this section is an assessment of the status of the technical data used by NSWCPD. LMI/ATI issued this survey to better understand NSWCPD's technical data practices at the beginning of the pilot. Table E-2 shows the engagement survey and the responses received from NSWCPD.

Table E-2. NSWCPD Engagement Survey and Responses

1. Is your current technical data produced in a 3D format? If yes what CAD software package(s) do you currently use?
Our proposed deliverable from EB is JT+PDF.
2. If you do produce 3D models do you also produce associated 2D data?
We don't, the shipbuilder does.
3. If you are providing 2D-only technical data, are there any plans to adopt 3D technical data?
N/A
4. If you are using 3D technical data, are you annotating Product and Manufacturing Information (PMI) to the model you are creating, i.e. GD&T, surface finish, notes etc.?
That is in-process with the shipbuilder.
5. Are there any programs/weapon systems under your authority for which only 3D technical data is currently available or will be available in the next 5 years? If yes, please identify the explicit program/weapon systems, when (month/year) they will enter the provisioning process (if applicable), and when they will begin seeking DLA support for sustainment.
N/A

Table E-2. NSWCPD Engagement Survey and Responses

6. Are there any programs/weapon systems under your authority for which legacy 2D data will be converted to 3D data and for which the ESA/PMO will no longer maintain and provide 2D data? If yes, please identify the explicit program/weapon systems and when (month/year) the transition will occur.
No.
7. What types of file formats make up your TDP package that supports each of your programs/weapon systems, i.e. native CAD, 3D PDF, JT, Excel, etc.?
Mostly PDF and JT+PDF.
8. Are there any programs/weapon systems under your authority that have adopted the use of 3D PDF for recording and distributing technical data? If yes, please identify the explicit program/weapon systems.
No
9. Is there any plan for programs/weapon systems under your authority to adopt 3D PDF for recording and distributing 3D technical data? If yes, please identify the explicit program/weapon systems that plan to do so.
No
10. If you have programs/weapon systems that will not or cannot adopt a 3D PDF file format for technical data, have you given thought to what format you will use to provide technical data to DLA? If yes, please identify the specific file format(s) and explain your rationale for adopting that format.
We don't develop, we only receive.
11. Are you aware of the data elements that DLA requires in 2D or 3D technical data to support provisioning and procurement of weapon system parts?
Yes
12. Are you aware of the viewable/readable 3D formats that are acceptable by DLA for use in provisioning or sustainment?
Yes
13. Are you interested in learning more about the research DLA has completed as it relates to recording and distributing 3D technical data?
Yes

Candidate Parts List

NSWCPD provided a TDP for training and to become familiar with the purpose of understanding how to use the JT2Go viewer. NSWCPD also provided a test TDP to be used by cataloging, provisioning, and sustainment groups to ensure that the technical data provided was sufficient to perform their jobs. Table E-3 lists the part candidate info for both TDPs.

Table E-3. Candidate Part List for NSWCPD Pilot

Part Name	Part Number
Piping Plumbing Missile Compartment Forward	LOA003313- R656-2301 Rev A
Logistic Escape Trunk Upper Hatch Operator Miscellaneous Details	LSA002848- R547-0251 Rev A

Pilot Summary

Observations and feedback obtained from NSWCPD and the participating entities throughout the pilot provided insight into the use of JT2Go to support model-based technical data packages.

The JT2Go software and JT viewer are valid options for supporting TDPs with 3D models that meet DLA's requirements for provisioning, cataloging, and sustainment. Other than having to learn the user interface of a different tool there does not appear to be a great deal of difference in the functionality of a JT based 3D TDP and a PDF based 3D TDP at this time. Representatives from each of the supply chain activities were able to do their jobs.

Getting all of the pilot participants to talk to each other and collaborate was a high value-added activity. This pilot facilitated communication between NSWCPD, Siemens, and EB that would not have otherwise occurred outside of the context of the pilot. The participants noted that this was a worthwhile exercise for learning and validation purposes. The LMI/ATI team further concluded that greater collaboration between program offices, OEMs, and PLM providers can result in heightened awareness of gaps, thereby prompting corrective actions. Specifically, the pilot revealed the versioning and date issues associated with earlier versions of the software. As a result, EB's chief information officer (CIO) is now putting some pressure on Siemens to make earlier versions of JT2Go available on their website so that all end users can retrieve EB's recommended version of the software as needed.

The Adobe software with 3D PDF is preferable to the JT2GO viewer with the JT file. JT2Go software with the JT file are the same. Our team notes, however, that the Adobe software allows users to save viewstate files and add dimensions and annotations to those viewstates. JT2Go does not share in this feature; users can take and save screenshots but cannot mark up the viewstate. The JT2Go viewer is not a commonly used software within the Government; as such, it requires IT approval for every new software release. The LMI/ATI team cautions that this conclusion may be due to the team's familiarity and experience with the Acrobat tool.

The concept of design disclosures is in its early use for the COLUMBIA Class submarine program. There were some differences between TDPs, which resulted in different approaches to locating technical data. The design disclosure concept that will be used for the COLUMBIA class submarine is in the development phase and the content and organization of the model used in the design disclosure has not yet been finalized.

There does not seem to be a consistent use of a global identifier to cross-reference objects in the EBOM and the JT product tree. The JT product view tree and the JT graphics window require the user to know the correlation between different identifiers. The unique identifier in the JT graphics window is the "Find Number," which can only be found in the source PLMXML file as a label and has no association with the part. The unique identifier, which is found in the source PLMXML file as a Product Instance ID, includes the Design Element (DE) and manufacturer's part number.

Pilot Discoveries

Adobe Plugin Summary

NSWCPD requested that LMI/ATI conduct an analysis of the Adobe plugin for JT2Go. Below is a summary on the use of the Adobe JT2Go Plugin.

One of the features of a JT+PDF document is the ability to click on a thumbnail image (similar to Figure E-6) of a particular view state within the 3D model or assembly and have the attached JT file open in that particular view state in JT2Go. To achieve this functionality from the PDF, the Adobe JT2Go Plugin is required.

Figure E-6. JT Thumbnail Image
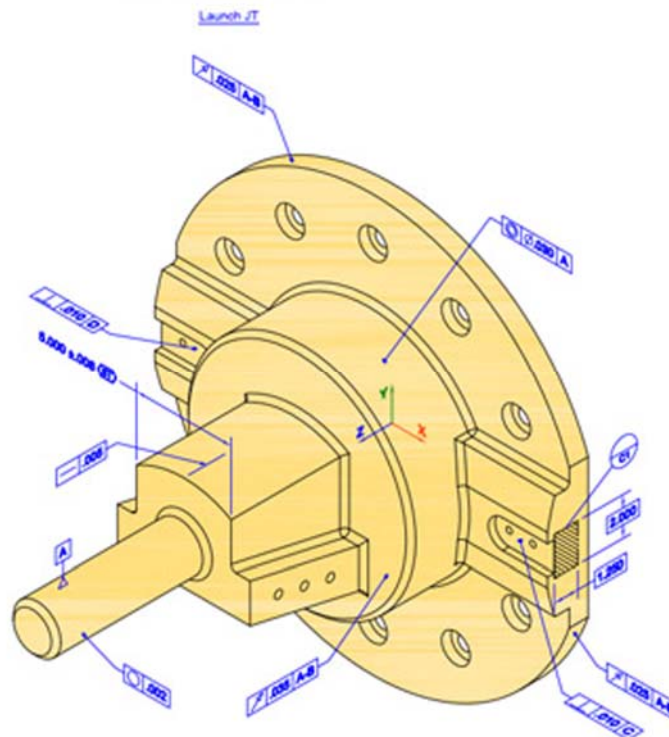
If the user clicks on the image as shown in Figure E-6, then the JT2Go application will run and the JT model will open as well. The model will be oriented as shown in Figure E-6, along with any annotations, PMI, dimensions, etc.

JT2Go v11.0 and higher displays a series of view state thumbnail images which the user can click on to manipulate the models in the same way eliminating the need for a plugin.

The attached JT model can be opened without the plugin installed, by clicking the "launch JT" link that is positioned above the thumbnail images within the document or by exporting the VFZ file from the PDF file to the file system and opening the file directly in JT2Go.

The Adobe Reader plugin runs a script that executes a command to open JT2Go which is prohibited on government networks for security reasons.

For the commercial user the best approach is install v11.0 or higher, which eliminates the need for the plugin.

Inch vs. Metric Summary

The JT2GO viewer has some measuring capabilities that can query the 3D geometry for dimensions such as linear, radial, and angler dimensions. By default, the JT2GO viewer has the measurement units set to metric. This can be changed by the user within the setting configurations within the JT2GO viewer.

After investigation by EB it was determined that the JT2GO viewer v11.3 would not allow end users to set and save default configuration of the measurement settings. This issue did not occur in Teamcenter Visualization Mockup due to EB setting the default to inches for all EB assets. The corrective action is to configure the defaults in v11.6 to be set to inches on EB assets. Root cause of the issue is due to Siemens natively utilizing the metric system in their programs out of the box, requiring configuration to update.

STEP File Analysis Summary

NSWCPD discovered that EB does not provide an AP203 STEP files as part of their TDP packages. NSWCPD asked LMI/ATI if it was possible to extract an AP203 STEP files from the JT+PDF file. They provided a file for evaluation. LMI/ATI determined that you could create an AP203 STEP file from the JT file if you had the proper translator which NSWCPD did not have. The extracted STEP file is a derivative of the JT file which in turn is a derivative of the native NX CAD format and was and not validated. After investigation with EB it was determined that Active Workspace has the capability to export STEP. NSWCPD took the Bearing Assembly JT+PDF Technical Data Package, exported a STEP file, and provided the STEP file to ATI and NSWCPD's Adaptive VE Lab for review. NSWCPD wanted the following questions answered: what level of data is provided, can the file be used to manufacture the part, and could the file be useful to DLA for an RFP.

The results of the review are as follows:
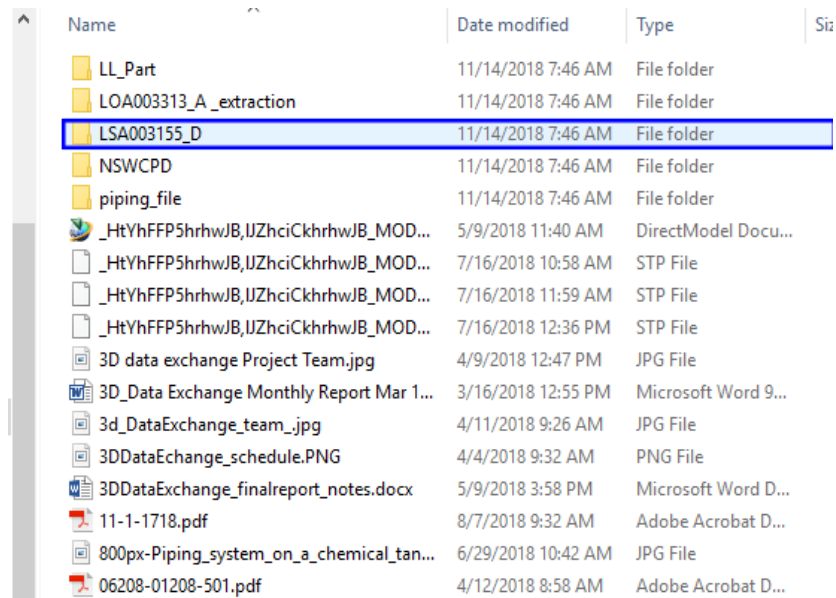
- **ATI:** The file imports as a five-part assembly. Of the numerous parts that make up the assembly, some come in with positioning errors. The errors could be Creo-related given that Creo requires every part to be fully constrained (i.e., each part must have an accurate coordinate system). The AP203 STEP for this assembly contained geometry only. To answer the question, could I manufacture? Any one of the parts could be imported into a computer-aided manufacturing software and code can be written to machine. There is no PMI, attributes, or parameters that give information like material, general tolerances, part revision, etc. Without these parameters, part inspection is infeasible. The file could be useful to DLA for use in an RFP as a reference file for creating machine code similar to the process that was used in the pilots projects that included a part acquisition.

- **NSWCPD—Adaptive VE Lab:** The review done by this lab provided the same results found by ATI. The AP203 STEP file was geometry only. The Adaptive VE lab did, however, import the file into a SOLIDWORKS CAD package and, using the measuring tools, they were able to obtain dimensions. It should be noted that the file was not a validated file.

EB Disclosure File Date Issue

At the beginning of the pilot project, the team received an initial TDP for a Piping Plumbing Missile Compartment Forward/LOA003313-R656-2301 Rev A from NSWCPD. LMI/ATI was asked to perform a task to find a particular part within the technical data package. LMI/ATI was using JT2Go viewer version 11.4. It was discovered that the Piping file could not be opened using JT2Go version 11.4. This caused some concerns because NSWCPD, NAVSUP, and LIS were able to open Piping file using JT2Go version 11.3. Further investigation revealed there was a date creation issue. For a step-by-step process of how to view the creation date issue, see below (Figures E-7 through E-9):

Extract the VFZ file from the PDF, change the extension to .zip, and unzip.

Figure E-7. Right Click on a File to get to Menu

Name	Date modified	Type	Siz
LL_Part	11/14/2018 7:46 AM	File folder	
LOA003313_A _extraction	11/14/2018 7:46 AM	File folder	
LSA003155_D	11/14/2018 7:46 AM	File folder	
NSWCPD	11/14/2018 7:46 AM	File folder	
piping_file	11/14/2018 7:46 AM	File folder	
_HtYhFFP5hrhwJB,lJZhciCkhrhwJB_MOD...	5/9/2018 11:40 AM	DirectModel Docu...	
_HtYhFFP5hrhwJB,lJZhciCkhrhwJB_MOD...	7/16/2018 10:58 AM	STP File	
_HtYhFFP5hrhwJB,lJZhciCkhrhwJB_MOD...	7/16/2018 11:59 AM	STP File	
_HtYhFFP5hrhwJB,lJZhciCkhrhwJB_MOD...	7/16/2018 12:36 PM	STP File	
3D data exchange Project Team.jpg	4/9/2018 12:47 PM	JPG File	
3D_Data Exchange Monthly Report Mar 1...	3/16/2018 12:55 PM	Microsoft Word 9...	
3d_DataExchange_team_.jpg	4/11/2018 9:26 AM	JPG File	
3DDataEchange_schedule.PNG	4/4/2018 9:32 AM	PNG File	
3DDataExchange_finalreport_notes.docx	5/9/2018 3:58 PM	Microsoft Word D...	
11-1-1718.pdf	8/7/2018 9:32 AM	Adobe Acrobat D...	
800px-Piping_system_on_a_chemical_tan...	6/29/2018 10:42 AM	JPG File	
06208-01208-501.pdf	4/12/2018 8:58 AM	Adobe Acrobat D...	

Right click on any of the files in the unzipped folder, (such as a JT file) and click "Properties."

Figure E-8. Click on Properties on the Menu
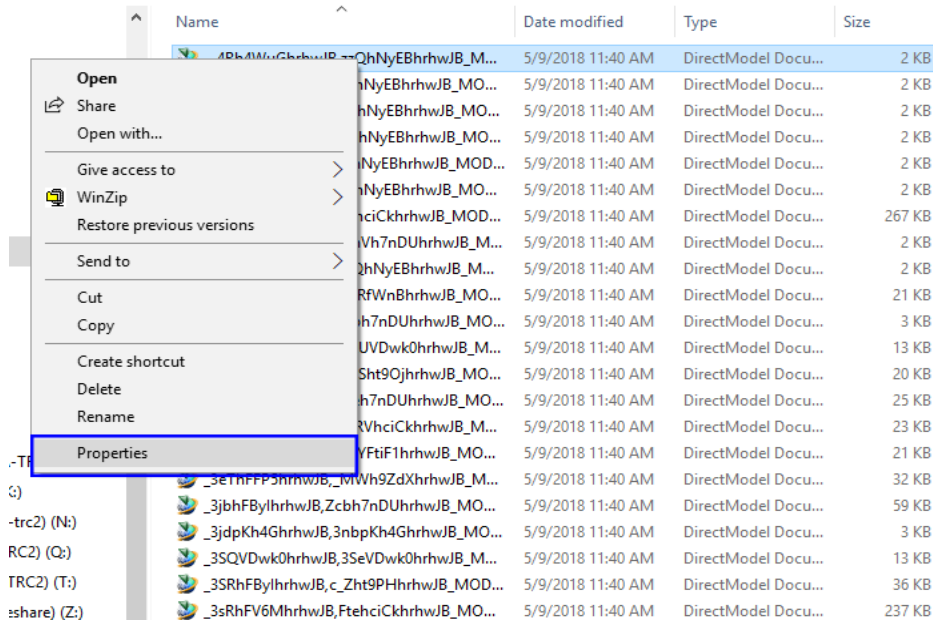
Notice the "Created" date. The problem is this date is dated back to 1969.

Figure E-9. Created Date Incorrect
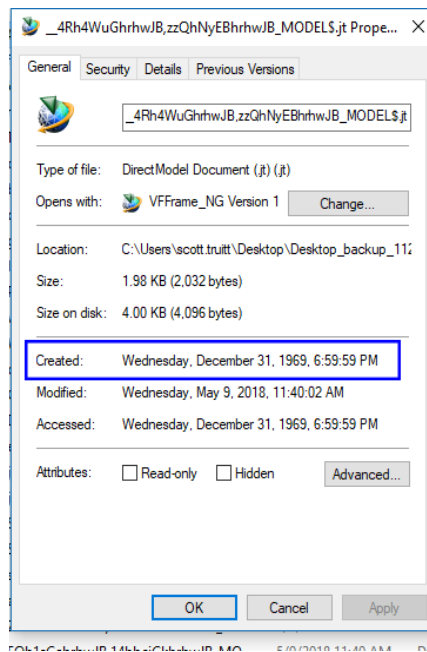
It was determined that version 11.4 and 11.5, of the JT2Go viewer, will not open files with the creation year date of 1969. For those using these two versions, a work around was developed to change the creation date of the file to a current date so it would open. EB and Siemens continued its investigation and EB provided the following summary to close the issue.

At this time, EB IT does not intent to take action to correct the creation date issue. Siemens determined that this issue is isolated to JT2GO v11.4 and v11.5, and expects that this issue will be resolved in subsequent versions. EB confirmed that v11.6 is working correctly and no longer contains this issue. Utilizing the versions of JT2GO recommended by EB is the best means to avoid this issue, currently v11.6.

JT2GO Viewer Version Availability

It was discovered early in the project that different entities such as NSWCPD and NAVSUP, which are on the NMCI network, and LIS, which is on a DLA network, need different Certificates of Networthiness (CONs). The Siemens website only provides a link to the latest version of the JT2Go viewer. This could be problematic from the government's perspective since they can only download the version that has a certificate. This was discussed with Siemens and the team suggested that they provide legacy versions on their website to include the version that has a certificate. Below is Siemens response to the issue.

In order to provide versions of JT2Go that meets the needs of both early adopters and those in the government who can only access versions that have a CON, Siemens PLM Software will make the following provisions for access. The latest version will always be posted on the JT2Go website. Early adopters and others, such as OEM's who may not need a CON, can access the latest version of JT2Go at https://www.plm.automation.siemens.com/global/en/products/plm-components /jt2go.html. Legacy versions of JT2Go will be posted to a Community site and will be provided to system administrators for distribution to their end users.

Training Summary

It was determined early in the project that the training slides provided by Siemens were acceptable. The slides, however, are rudimentary and do not provide instructions for the functions needed by NSWCPD, NAVSUP or LIS. NSWCPD asked if it would be possible to create some training videos that would help the user become more familiar with the JT2Go viewer capabilities. Siemens did provide several links to training videos. Once again, however, these videos were rudimentary. It was determined that having DLA-specific use cases would help Siemens improve their trainings. NSWCPD provided two uses cases for consideration:

1. A video that was specific to using the parts tree for searching

2. Toggling PMI on and off. Siemens developed a short video to the team on "parts tree for searching."

The NSWCPD response to the issue follows:

The video does capture some of the aspects I had proposed for coverage, but there is only one thing missing as far as I can tell. I used the video as Mike suggested, starting and stopping as I progressed and opened one of the COLUMBIA files to try and follow along. I identified a piece in the Engineering Parts List (EPL) and tried to find it using the video techniques. One thing I noted was that the video could use some more explanation of the search criteria for the tree. Since I used the EPL to find my part, like any logistician would, I was focused on the part description. Since none of the item descriptions returned any values I adapted my search to the EB part number. That worked as it is part of the product structure tree. In hindsight, this makes sense, but we

are trying to train by the most direct method. If the video was to site text or manufacturer's part number (which ever the tree is based on), then maybe it can be more effective the first time. Everything else about the video was satisfactory for this concept.

Siemens provided below their feedback on training videos and the impact it could have:

Creating user scenarios are more effective training than just running through features. We did create videos on how to search using text, on measurement, and on opening model views to support the pilot users. Our focus was to make them short and targeted to support challenges encountered during the pilot. Siemens can create custom training for any customer, and normally recommends that feature vignettes be tied together to support a scripted story germane to the customer's processes. For instance 1) open the model view named <provide a name>, 2) investigate the model for cost of manufacturing, 3) investigate tolerances on dimensions, and 4) identify material to support Provisioning. We have also discussed videos on setting up the JT2Go application on end user desktops, including preferences and ribbon menus, but that is often a site-specific task constrained by local IT security measures. But it is also something that can be accomplished by scripted installations by the same IT security team to meet the needs for each site.

Pilot Team Feedback

Once developed, NSWCPD submitted its JT+PDF files to the designated supply chain activities. In this pilot, the designated supply chain activities included NAVSUP, LIS, and DLA Land & Maritime. Each of these supply chain activities provided feedback on the TDP provided by NSWCPD and stated whether or not the TDP as delivered would support their respective duties. The direct feedback from the provisioning activity, the cataloging activity and the supply center is below. This section also includes direct feedback from the pilot partners at NSWCPD, the product lifecycle management (PLM) tool representatives from Siemens, and the OEM representatives from EB. The LMI/ATI team also collected comments from SUPSHIP.

Technical Support Activity (NSWCPD)

Background

Although DLA has some experience with 3D PDF, they have no experience with the JT format. This prompted them to commission the group of technologies experts that they used to evaluate 3D PDF disclosures to provide the same insight for JT. The lead company was LMI and their counterpart ATI. As a team following NSWCPD direction, we are seeking to conduct a pathfinder project from the issuance of a design disclosure by the shipbuilder all the way through the procurement of the end item. Code 315 will provide feedback to PMS-397 regarding the findings of this effort.

Beginnings

Once the stakeholder personnel were established, we identified the requirements for each activity to obtain the required software (the JT2Go reader) and obtained contacts in each activity to work with us.

The first issue encountered was that the agencies in the provisioning and procurement chain are not on the same network and the methods and approvals to obtain the

required JT2Go reader software were different. Compounding the matter, DLA ended up with different versions of the software approved for their network and personnel usage. This did not present a problem until we tried to socialize the preliminary file to ensure the ability to use the software. It was found that the version 11.3 and prior could open the files provided by the shipbuilder, but version 11.4 or higher could not.

LMI and ATI reached out to the software developer Siemens and conducted a familiarization meeting with them and Code 315 to discuss how we would use the reader and our desires for capability. Siemens has identified the issue related to the different reader versions as a generic created date in the file coding. Using that information, ATI and LMI have confirmed that correcting the data does resolve the issue. This information has been passed back to EB and they are currently working on correcting it and providing us a disclosure for the chosen LSA that meets this multi-version requirement.

Preparation

While we were working through network approvals for the software, Code 315 presented an initial design disclosure to ATI and LMI to validate if JT+PDF design disclosure outputs were sufficient. There was only one item on the design disclosure that did not reference related 2D drawings so ATI and LMI captured the geometry of a gasket from this design disclosure. They determined that we could process the data as basis for the isolation and creation of a STEP format file.

The next step was to select a design disclosure of an assembly that contained parts having PMI without reference to 2D drawings. Another concern for selection of the pilot equipment was the size, complexity, and cost of the item, since we wanted to take the item all the way through procurement at this early stage.

We identified a pilot disclosure LSA002848 LOGISTICS ESCAPE TRUNK (LET) UPPER HATCH OPERATOR MISCELLANEOUS DETAILS. It is an assembly with 11 components and only one minor modification and all are fully described on the disclosure.

While the pilot project was on hold due to the date issue, Code 315 learned that a STEP file is usable in not only CAD platforms, but also various display and interactive platforms from virtual/augmented reality to Interactive Electronic Technical Manuals. Code 315 therefore worked with ATI to determine if they could isolate the STEP file data for the bearing (R5470251-8) on the subject disclosure. In order to validate the STEP file, Code 315 contacted Code 326 Advanced Machinery Systems Integration to attempt to accomplish a 3D replication of the bearing. On August 14, 2018 Code 326 executed the print and produced the facsimile of the bearing. Although it was not made with the same materials called out in the disclosure, the intent was to evaluate if this file correctly captured the geometry of the item.

The 3D printed bearing was then provided to Code 434 as ISEA for the LET system for evaluation of the geometry per the disclosure. Code 434 confirmed that this was to the PMI called out in the disclosure. Since the data exists in the JT+PDF disclosures provided, it offers another set of capabilities to consider for the SEA06L Digital Transformation initiative.

Pilot Execution

In order to move forward while waiting for software updates from EB, we accepted a corrected version of the JT+PDF file for the LET Operator that would allow manual access by all versions of the reader. Using this file, it was entered into the Naval Ships Engineering Drawing Repository (NSEDR) for access by NAVSUP and DLA and EB submitted an ICAPS file to execute the provisioning process. We were able to process the TDP and release the ICAPS file to NAVSUP. NAVSUP was also able to fully process the project and submit SSRs to DLA. Likewise, DLA was able to process and catalog the SSRs successfully.

Post Pilot

After the pilot project was processed, EB personnel demonstrated the capability to extract a STEP file from Active Workspace. These files were shared with ATI and Code 326 for basic evaluation. These files were found to be compatible with CAD software for visualization and possible manufacturing applications, but are at this time not validated. The potential for this data will need to be further explored by PMS 397.

Conclusions to Date

The TSA finds that once details of reference number format, date conflicts and PMI access for all levels and types of disclosure are resolved, the JT+PDF format would be acceptable for Provisioning and Life Cycle support purposes to the Supply Support community. The level of detail provided at the LSA disclosure level is sufficient for these purposes if the lessons learned during the conduct of the pilot project are recorded and absorbed.

Provisioning Activity (NAVSUP)

Piping Plumbing Missile Compartment Forward

LOA003313—R656-2301 Rev A

Although I was able to open the JT2GO application directly from within Adobe Pro, isolating the 3D representation for the specific part (i.e., R6562301-F106 218036212—full face gasket) was difficult at first. The controls and many options for JT2GO are confusing for those not used to it. Initially I was unable to consistently identify all dimensions and placement for each of the holes relative to each other and to the outside edge. On several occasions the JT2GO application crashed and on others did not know how to select a new measurement once one was made. I attribute this to my own inexperience in the software, but will say that it does not feel intuitive and suspect that many will experience frustration while attempting to measure in a 3D environment on more complex parts than a simple gasket. Training will be essential going forward to quickly, consistently, and reliably pull dimensions.

Logistic Escape Trunk Upper Hatch Operator Miscellaneous Details

LSA002848—R547-0251 Rev A

During this phase the JT2GO and PDF drawing were changed slightly to ensure compatibility with all JT2GO versions. Once I was shown how to extract the VFZ file from within the PDF, I was able to easily launch JT2GO and find the required parts. Since all new parts within this pilot program will be DLA managed, the actual dimensions will be

reviewed by the DLIS cataloger. However, I was able to replicate most of the 2D dimensions of R5470251-8 on page 26 of the PDF and compare them to the 3D version in JT2GO after a few tries. It's easier, but training and evaluation would be a good idea to make sure that I and others pull the measurements correctly. I would say that this particular drawing (as compared to LOA003313) was much easier as the components are also laid out in the traditional 2D perspective in addition to the 3D JT2GO. Obviously, the 3D environment provided much more detail as to how the parts fit together relative to each other as well as a whole assembly.

- One question I had was the medium that was contained within the compensator once assembled and tested. To better place the whole assembly 167-8617384 ASSY-A1 within DLA's H2 and H6 catalog with a definitive and approved item name, it helps to know if the force applied is through direct physical contact, or indirectly by air or a fluid such as hydraulic fluid or oil. Although this is a DLA cataloging function, we try to recommend accurate Federal Supply Classes when possible. If this item would have been a Navy-managed item the same would have been applied as we have internal codes to link to Navy Program and Item Managers.

Overall Final thoughts: Besides my own inconsistent dimension retrieval in JT2GO, the rest of the process was straight-forward and enjoyable. Since this pilot program is really set up for DLA I look forward to reading their review and receiving more training on JT2GO.

Cataloging Activity (LIS)

Logistic Escape Trunk Upper Hatch Operator Miscellaneous Details

LSA002848—R547-0251 Rev A

The 2D drawing was successfully pulled from [Naval Ships Engineering Drawing Repository] (NSEDR) and the 3D portion was viewable using the JT2GO software. It was established that the drawing was acceptable for cataloging purposes. NSNs of Type II 1 were established for two of the items and the other three were Type II 4 due to limited characteristics and the fact the drawing was of the entire assembly and not an individual drawing of the piece parts.

For one item, the spring, all characteristics came from the 2D portion of the drawing. The parts list was also only contained in the 2D portion, which gave the material for the items. The notes section contained in the 2D portion was valuable to give the function of the assembly itself.

The parts tree within the 3D drawing is difficult to navigate, if the drawing contained more piece parts it would be very time consuming to locate the individual parts.

Purely from a cataloging perspective the 3D portion did not add much value because all the same information was contained in the 2D portion of the drawing, along with additional information in the 2D portion that is noted above. The parts list is contained in the 2D portion and gives material, the notes in the 2D portion also lead to the function of the item. The spring information was solely pulled from the 2D portion.

Without proper training, the cataloger would have a difficult time navigating the 3D drawing. The cataloger, after realizing all the information is contained in the 2D portion would most likely use just the 2D drawing for ease of use.

Below is NSWCPD JT Pilot NIIN Characteristics Summary provided by LIS Cataloging.

The NIINs listed below are Type II 1 which means all of required characteristics of the part were found.

NIIN 016784158—Reference number 3120-01-678-4158
ITEM NAME: BUSHING, SLEEVE

NIIN 016784737—Reference number 3040-01-678-4737
ITEM NAME: PISTON, LINEAR ACTUATING CYLINDER

The NIINs listed below are Type II 4 which means that some of required characteristics of the part were found.

NIIN 016784897—Reference number 53711 167-8617384 ASSY-A1, INC 20978, Type II 4.

AMTF—Port Screw Thread Diameter. No dimensions or material for the entire assembly.

NIIN 016784891—Reference number 61020 3-550-500-444-F, INC 40088, Type II 4.
AAZE—Shank diameter
ADYT—Center hole diameter

NIIN 016784331—Reference number 53711 167-8617384-12, INC 04226, Type II 4.
AXJQ—Spring solid length
AXLQ—Spring free outside diameter
AZLH—Coil helix direction
AXLP—Spring deflection rate

No information from the 3D drawing obtained.

Sustainment Activity (DLA Land & Maritime)

Piping Plumbing Missile Compartment Forward

LOA003313—R656-2301 Rev A

The 3D display is intuitive and easy to navigate. It is very useful being able to select and view only certain pieces from the entire assembly, but it would be nice if the callouts to the deselected pieces disappeared along with the models. In a similar vein, once I enabled the "Show PMI" option, the screen became incredibly cluttered and I was unable to actually read any of the PMI in a useful manner. In one of the training videos I watched, a model view was selected which showed all of the required dimensions for a casting. On this sample file I was not able to accomplish anything similar, the model view was only available for certain parts and I could not locate any dimensional data. The lack of dimensions is my main concern, I'm not sure if the data is missing or I just lack the experience to pull it up.

Logistic Escape Trunk Upper Hatch Operator Miscellaneous Details

LSA002848—R547-0251 Rev A

Our Product Data Specialist was able to access this drawing from NSEDR and load it into our Document Management System (DMS) without any problems. This drawing is much better than the initial TDP and addressed all of my concerns except for the excessive PMI issue discussed below in my initial TDP summary. NSNs 3040-016784897, 3120-016784158, 3040-016784737 and 5360-016784331 look good and have all of the required information DLA would need for procurement purposes.

My only issue is with NSN 4820-016784891. The controlling reference is CAGE 61020 P/N 3-550-500-444-F, it is unclear to me whether this Part Number meets the requirement for 167-8617384-10 or if modifications are required per the drawing. If the Part Number meets the requirement, we'll just have to change the AMC/AMSC from 1/G (representing full and open competition) to something like a 3/D (buying from an approved source). I think this can be easily cleared up on our next call.

EB

EB's Maintenance Authority Customer Outreach started in October 2016 with a face to face meeting of the Maintenance Authority Core Lead, External Collaboration Lead and the NSWCPD office in Philadelphia. The NSWCPD team is the first life cycle organization outside of EB to utilize electronic design disclosure, specifically for provisioning. The NSWCPD team kicked off this pilot to exercise their use cases and the results have been extremely informative. The team has developed a much more detailed understanding of the design disclosure products and a better understanding of NSWCPD requirements with respect to drawing/disclosure utilization. Throughout the pilot, some issues were discovered with respect to creation dates, versioning, and the availability of the recommended version of the JT2Go software for users outside of the NMCI network. These issues are being resolved with support from the software provider, Siemens. The team in Philadelphia was able to use additive manufacturing to produce one of the objects from a model file extracted from the disconnected version of EB's disclosure (in JT+PDF format). This was a major milestone given this was the first time the Maintenance Authority Core Team documented Navy execution of model-based manufacturing using a design disclosure. In addition to manufacturing the item, the NSWCPD team was able to upload the file to NESDR after some minor IT work to enable the file type to be consumed.

The provisioning use cases related to outsourcing and vendor collaboration have been omitted from the pilot, which was inconsistent with the vision to glean as much information as possible from the exercise. The justification for this omission was related to two factors: 1) The disclosure provided had more PMI than will be provided going forward, and NAVSEA determined that it was not as representative as it should be for a full understanding of the impact of reduced annotations. EB disagrees with this rationale given that it will be informative to understand how the level of annotation on the disclosure was received by the vendor base and how it was utilized. 2) The procurement of actual material is not funded through this pilot funding stream. EB believes that vendor input and collaboration should have occurred regardless of whether material was actually procured to ascertain vendor requirement gaps and concerns with working with a design disclosure in lieu of a drawing. Based on EB's experience with vendor reaction to design disclosure, it is imperative to engage the vendor base as early as possible.

EB congratulates the NSWCPD team for their successful execution of this pilot study. It is critical that other branches of the customer base continue with similar pilots and engage EB's Maintenance Authority Team to assist with problem resolution.

It should be noted that the pilot had no impact on EB whatsoever other than to validate that our disclosure worked for the provisioning use cases. If there were to have been an impact, we would only have been able to take action through direction by NAVSEA. Positive outcomes included discovering the versioning and date issue. In addition, our CIO is now putting some pressure on Siemens regarding making earlier versions of JT2Go available on their website so that all end users can retrieve EB's recommended version of the software as needed.

Siemens

Siemens has a long history of providing tools for defining, disclosing, and leveraging of technical data across industrial enterprises. We have been and remain committed to providing standards-based tools and data across our growing Digital Industries Software enterprise suite of tools. We recognize that our ability to provide offerings, that can span decades and maintain relevance, requires long term partnership with our clients as we collectively evolve and bring our tools and our customers' data forward across generations of technology. Collectively, we (government and industry) are in a generational change process, moving into a model-based world, where we see first-hand challenging cultural and technology change impacts/interactions. This is the case with model-based disclosures, where workforce demographic generational changes interplay with technology evolution and real-world adoption challenges. We have come through the interim stage of moving from model-based 2D data disclosures to "3D drawing-based" disclosures, and are now in the process of what will become the next stage of maturation in 3D model-based disclosures.

From this perspective, we have been very pleased to support this effort with DLA, NSWC, ATI, LMI, and Electric Boat to learn and share. This has been a productive opportunity to learn and functionally detail several key use cases outside of the traditional engineering and manufacturing ecosystem, including details about provisioning and cataloging use cases for supply chain users. We were grateful to have the opportunity to share where we have come with our tools to date, clarify outstanding questions that different team members had, and help to create some educational material for users.

We see this exercise as timely and critical for the DoD and its entire ecosystem. Determining viable and useful formats for model-based TDPs is an imperative for the success of any Digital Transformation plan across the DoD. We see this impacting every Agency, Service, PEO, SYSCOM, and Program. We see the outcomes of a project like this impacting:

- A dramatic reduction in the variation of model-based TDP deliverables to the DoD.

- The ability of various logisticians to intuitively and effectively make use of model-based TDPs in their daily work.

- The definition of constructive contract requirements, and more closely defined data standards.

- Ultimately, realizing the value of the MBE through TDP reuse, positively impacting readiness and the speed and affordability of delivering lethality.

- And correspondingly important to industry supportive of government needs. Siemens will use this input to calibrate our vision and development plans.

Siemens would like to continue working with the team, and potentially additional members, to further mature the definition, disclosure, management, and intuitive access to data for the DoD ecosystem. We would look forward to working collaboratively in the following areas:

- Discovering additional contextual use cases for the various people who interact with technical data.

- Sharing and developing methods for completing a closed loop digital thread using standards-based technical data packages.

- Discovering how model-based disclosures may impact and drive constructive changes to SD-19 and SD-22.

- Providing the group members an updated appraisal of Siemens' tools evolution as technology and data developments continue.

SUPSHIP

The function of SSGR within Navy ship acquisition is oversight of contract execution, which is applied in various ways. SSGR's participation in the DLA pilot was limited to observation about the completeness and usability of the CLB design products for this purpose. There are two key points of interest about the findings: the ability to perform the necessary operation and the efficiency of the system when performing those operations.

The findings of this pilot will contribute to the requirements definition that SSGR Engineering will use to accept the design products for the Navy, and that NAVSEA will use to further define programmatic requirements. Hence, the expenditure to conduct a formal evaluation of those two aspects of the COLUMBIA design deliverable will be extremely beneficial to the development of the COLUMBIA program methods.

The pilot was well executed, although an expanded set of design products and use cases might have provided more definitive results. The approach to use a consulting service to manage the pilot was the right choice since this provided third party objectivity and the ability to apply focused management to the project.

Gap Assessment

1. The JT2Go viewer is not intuitive for new users. Controls and options for JT2Go viewer are confusing.

2. The training material was rudimentary. Training for the specific uses cases within NSWCPD, LIS, NAVSUP, and DLA sustainment would be helpful.

3. Certificate of Networthiness (CON) for newer versions could be problematic. The process to obtain a CON is lengthy. Currently the CON on NMCI and DLA networks is v11.3.

4. Siemens does not provide legacy versions of the JT2Go viewer on their website. Could be problematic for government sites without a CON on the latest version.

5. The provisioning and procurement chain are not on the same network. Methods and approvals to obtain the required JT2Go viewer software are different for these networks.

Conclusions

Based on the documentation and results of the NSWCPD pilot, LMI/ATI drew the following conclusions:

1. The JT2Go software and JT viewer are valid options for supporting TDPs with 3D models that meet DLA's requirements for provisioning, cataloging, and sustainment.

    a. Other than having to learn the user interface of a different tool there does not appear to be a great deal of difference in the functionality of a JT based 3D TDP and a PDF based 3D TDP at this time.

    b. Representatives from each of the supply chain activities were able to do their jobs.

2. Getting all of the pilot players to talk to each other and collaborate was a high value-added activity.

    a. This pilot facilitated communication between NSWCPD, Siemens, and EB. Without this pilot, communication between the NSWCPD, EB, and Siemens would not have happened. The pilot was worthwhile because of the interaction between all the players, which does not happen all the time.

    b. EB representatives noted that this was a worthwhile project since it was one of the few times they had participated in a pilot as inter-disciplinary as this one.

    c. Recommendation: Figure out how to continue to work together as a team after pilot closure.

    d. Positive outcomes included discovering the versioning and date issue. In addition, EB's CIO is now putting some pressure on Siemens regarding making earlier versions of JT2Go available on their website so that all end users can retrieve EB's recommended version of the software as needed.

3. The team consensus was that the Adobe software and 3D PDF is preferable over the JT2GO viewer and the JT file.

    a. This impression may be due more to familiarity and experience with the Acrobat tool than actual limitations with JT2Go viewer.

    b. JT2Go viewer is not software commonly used by the government and as such requires IT approval for every new software release.

    c. There are some feature differences in Adobe reader vs. the JT2Go viewer. For instance, the Adobe software allows users to save viewstate files and add dimensions and annotations to those viewstates. JT2Go does not share in this feature; users can take and save screenshots but cannot mark up the viewstate.

4. The concept of design disclosures is in its early use for the COLUMBIA Class submarine program.

   a. There were some differences between TDPs that resulted in a difference in how to locate technical data.

   b. The design disclosure concept that will be used for the COLUMBIA class submarine is in the development phase and the content and organization of the model used in the design disclosure has not yet been finalized.

   c. Standard practice in the commercial US shipbuilding industry is the content and organization of the model may vary across applications.

   d. There does not seem to be a consistent use of a global identifier to cross-reference objects in the EBOM and the JT product tree.

   e. Navigating among the JT graphics window, the JT product tree view, the PLMXML file, and the Engineering Parts List requires the user to know the correlation between different identifiers.

   f. The unique identifier in the JT graphics window is the Find Number which can only be found in the source PLMXML file as a label and has no association with the part.

   g. The unique identifier in the JT product structure include the DE and manufacturers part number and can be found in the source PLMXML file as a Product Instance ID.

Appendix F
U.S. Army Aviation and Missile Research Development and Engineering Center Creo View Pilot

Introduction

This pilot validated whether OEM-provided CATIA technical data, which was converted to a PTC Creo View format, is viewable using the PTC Creo View, OpenText IMAGENATION 3D, and Brava viewers and provided feedback to ensure that the OEM-provided technical data can meet DLA engineering and sustainment needs.

LMI/ATI opted to pilot with AMRDEC and DLA Aviation because 1) AMRDEC was very interested in ensuring that the technical data would provide in 3D format would be sufficient for procuring parts and 2) DLA Aviation was very interested in being prepared to receive the Creo View file format (.pvz) from AMRDEC as their preferred technical data format and in viewing the file using the Creo View viewer or OpenText viewer. Prior to this pilot, DLA Aviation had no experience using technical data in the Creo View format or using Creo View viewer software. They did have prior experience using the OpenText viewer.

The pilot involved working with AMRDEC to obtain the technical data required for the pilot. The team worked with J6 EBS Production Support from Columbus to ensure the correct version of the Creo View viewer was installed and that it met government IT requirements. The OpenText viewer was already installed on their network. DLA Aviation at Richmond performed the required validation.

Roles and Responsibilities

Validating a TDP required a series of steps and involvement from multiple stakeholders. The pilot team included representatives from AMRDEC (ESA), J6 EBS Production Support, supply center activities, and R&D contractors. Table F-1 lists the stakeholders and their roles.

Table F-1. Pilot Team and Roles

Organization	Role
LMI/ATI	Facilitator
AMRDEC	Engineering Service Activity
J6 EBS Production Support	IT Support
DLA Aviation	Supply Center

Figure F-1 illustrates the workflow and responsibilities for the AMRDEC Creo View pilot. The R&D contractor team was comprised of representatives from LMI and ATI. LMI/ATI

facilitated the pilot, provided the technical data, trained to use the Creo View software, reviewed deficiencies, identified and documented deficiencies, and collected and documented lessons learned.

Within the workflow below, AMRDEC provided the technical data in the .pvz file format to be used in the pilot.

Finally, Richmond supply center was responsible for installing the Creo View Lite software, reviewing the technical data package provided in the .pvz file format, documenting and providing feedback on the use of the Creo View Lite software, and review the technical data to ensure they could perform their job function and document the results and deficiencies.

Figure F-1. AMRDEC Creo View Pilot Process Workflow
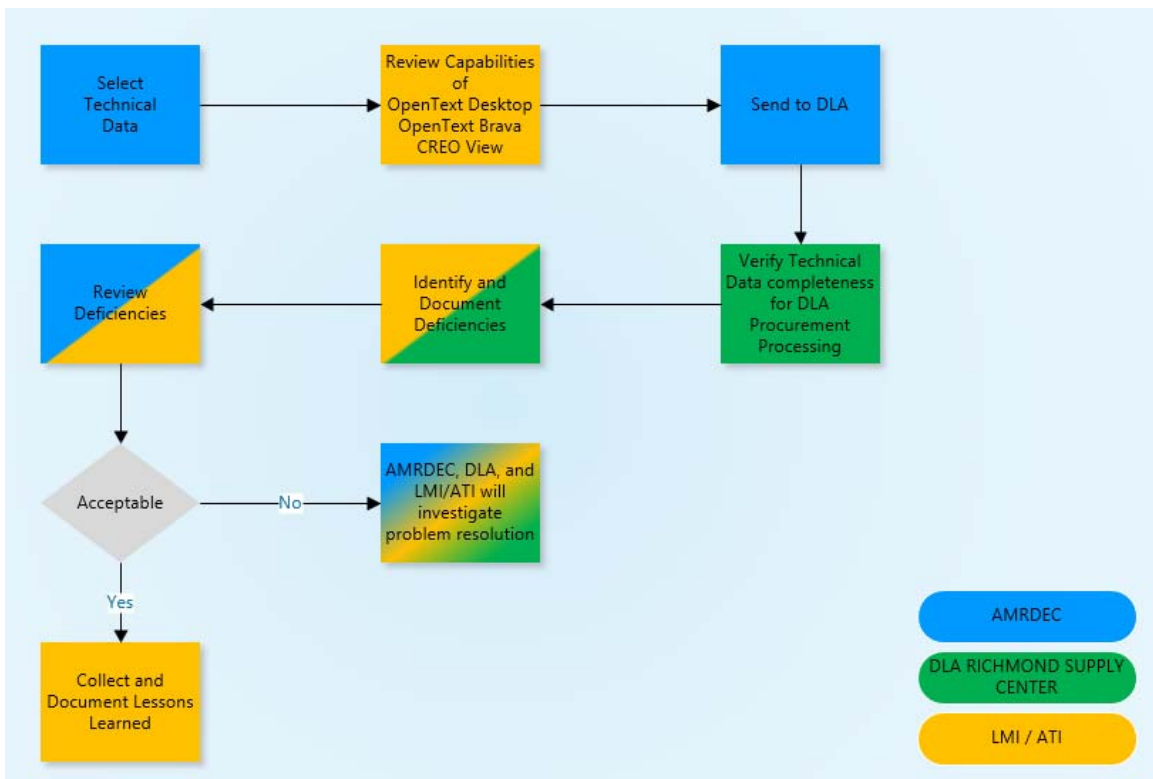
Schedule

The AMRDEC Creo View pilot ran from January 15, 2019 through July 10, 2019. LMI/ATI documented process and technology feedback throughout the project. Figure F-2 shows the AMRDEC Creo View Pilot schedule.

Figure F-2. AMRDEC Creo View Pilot Schedule

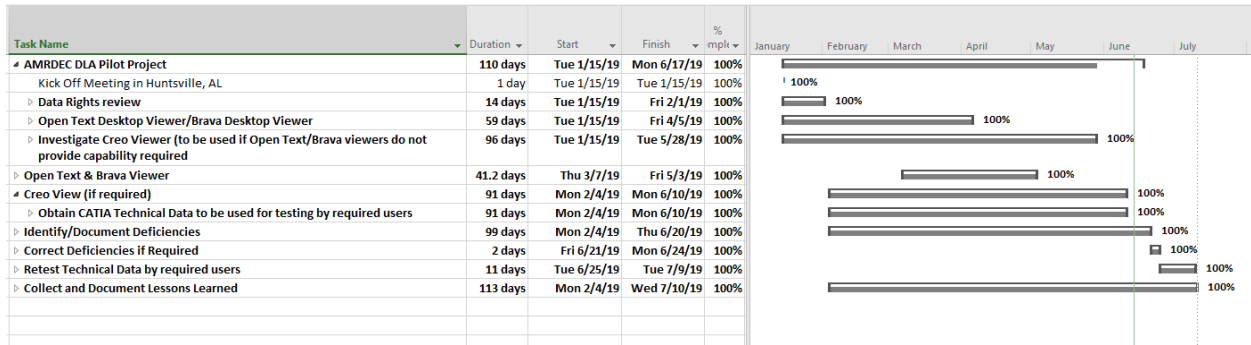| Task Name	Duration	Start	Finish	% mplt								
					January	February	March	April	May	June	July	
▲ AMRDEC DLA Pilot Project	110 days	Tue 1/15/19	Mon 6/17/19	100%								
Kick Off Meeting in Huntsville, AL	1 day	Tue 1/15/19	Tue 1/15/19	100%	100%							
▷ Data Rights review	14 days	Tue 1/15/19	Fri 2/1/19	100%	100%							
▷ Open Text Desktop Viewer/Brava Desktop Viewer	59 days	Tue 1/15/19	Fri 4/5/19	100%			100%					
▷ Investigate Creo Viewer (to be used if Open Text/Brava viewers do not provide capability required	96 days	Tue 1/15/19	Tue 5/28/19	100%				100%				
▷ Open Text & Brava Viewer	41.2 days	Thu 3/7/19	Fri 5/3/19	100%				100%				
▲ Creo View (if required)	91 days	Mon 2/4/19	Mon 6/10/19	100%					100%			
▷ Obtain CATIA Technical Data to be used for testing by required users	91 days	Mon 2/4/19	Mon 6/10/19	100%					100%			
▷ Identify/Document Deficiencies	99 days	Mon 2/4/19	Thu 6/20/19	100%						100%		
▷ Correct Deficiencies if Required	2 days	Fri 6/21/19	Mon 6/24/19	100%						100%		
▷ Retest Technical Data by required users	11 days	Tue 6/25/19	Tue 7/9/19	100%							100%	
▷ Collect and Document Lessons Learned	113 days	Mon 2/4/19	Wed 7/10/19	100%							100%	

Candidate Part List

AMRDEC provided a TDP to test the Creo View Lite software and the OpenText viewer software. The testing was performed by engineering, technical quality, and product specialist groups to ensure that the technical data provided was sufficient to perform their jobs. Table F-2 lists the part candidate info for the TDP.

Table F-2. Candidate Part List for AMRDEC Creo View Pilot

Part name	Part number
SHAFT ASSY, SUPPORT, COCKPIT TRANSFER BELLCRANKS	114C1217-1
IDLER ASSY—PITCH, INTERMEDIATE SYSTEM	145C1458-3
PLATE	219S1985-22

Pilot Summary

When using Creo View Lite, the team had the ability to view the .pvz viewable files and the STEP AP203 files provided by AMRDEC and deemed the testing successful. DLA Aviation did not test Creo View Express because they did not receive approval to load that software. LMI/ATI advised that the differences in the two softwares were not enough to pursue approvals.

The J6 EBS Production Support team provided the following summary for their participation in the pilot. The Creo View viewer software was received by the J6 team but they ran into some difficulties getting approval to install on their network. It was suggested by the DLA Aviation team to consider loading the software on an off-network computer to perform testing. J6 agreed to this and submitted a work ticket to have the software installed on the off-network laptop at DLA Aviation. Because it was installed on an off-network laptop, J6 did not test the software.

Pilot Team Feedback

AMRDEC Summary

AMRDEC was cautiously optimistic regarding the feasibility of leveraging currently agreed upon contractually delivered 3D technical data (i.e. type, format, etc.) to support DLA procurement actions. As more of our OEMs provide data derived from their in-

house PDM applications, we need to bridge the gap between legacy 2D data/formats and 3D MBD technical data sets. The pilot effort was very beneficial for us as it identified gaps that would need to be addressed before items could solely be procured through 3D MBD produced technical data sets. The pilot furthered demonstrated that the current technology (PTC's Windchill and associated modules) platform can be leverage by DLA for 3D viewing and interpretation; the focus needs to be shifted instead to processes (contractual language, standards, etc.) and people (training, what is MBD, etc.).

The consensus from LMI/ATI testing showed the following:

Evaluation of OpenText Viewer Summary

1. The evaluation was performed using the technical data provided by AMRDEC.

2. Downloaded and installed the trial version of OpenText. We attempted to open the following files.

   - .pvz   Windchill output file
   - .CATPart   CATIA model file
   - .CATProduct   CATIA Assembly file
   - .stp   AP203 file

3. The results of our evaluation on the above file types was the OpenText viewer (trial version) would not open any of the above files.

4. In summary the OpenText viewer (trial version) determined not to have the required capabilities for DLA Aviation to perform engineering or sustainment activities using AMRDEC technical data.

Evaluation of Creo View Lite and Creo View Express (free version) Summary

1. The evaluation was performed using the technical data provided by AMRDEC.

2. ATI already had a license for Creo View Express and AMRDEC provided a license of Creo View Lite to use in the evaluation. We attempted to open the following files.

   - .pvz   Windchill output file
   - .CATPart   CATIA model file
   - .CATProduct   CATIA Assembly file
   - .stp   AP203 file

3. The evaluation determined that we were able to open and view the .pvz file format using either viewer. The data that was found included some PMI annotations, as well as metadata such as material, notes, cage, part, revision history, etc.

4. Additionally, it was determined that the stp file could be opened and we were able to view geometry. **Note:** Creo View Express cannot open the stp file.

5. In summary Creo View Lite and Creo View Express would have the required capabilities for DLA Aviation to perform engineering and sustainment activities using AMRDEC technical data.

The consensus from the DLA Aviation testing showed the following:

Evaluation of OpenText Viewer Summary

1. The team members from DLA Aviation tested the AMRDEC technical data using OpenText viewer. The team members were from Engineering, Product Specialist, and Technical Quality.

2. OpenText IMAGENATION 3D viewer would not open the .pvz files; it only opened as a listing of the files in the folder. The users had no success with viewing any of the provided files for this AMRDEC Pilot using OpenText viewer.

3. The consensus from the team was based on the technical data received, is that OpenText would not allow us to perform our jobs in the technical quality, engineering, or product specialist areas.

Evaluation of Creo View Lite Summary

DLA Aviation, Richmond conducted a test of 3D data provided by AMRDEC for the Creo View Pilot. The comments of the group was consolidated to reflect the team's feedback on their experiences navigating the Creo View software and the adequacy of the technical data provided.

In regard to our test with Creo View Lite, team members were able to successfully run the software to open some of the provided model data. We were able to open data from the STEP files and viewable folders with extensions of stp and .pvz, respectively.

The model was visible as a 3D solid figure. There were some overall dimensions that were shown, which is helpful to discern part size and the locations of some of the part features it contains. The information that is contained in the 114C1217-1 .pvz file from the Viewable folder contained **some, but not all,** of the information that is needed to analyze a part as well as build a technical data package within our repository using associated metadata.

The team was able to view the part with some dimensions and additional metadata such as:

- Part Number
- CAGE Code
- Nomenclature
- Export Control Warning
- Copyright Information
- Distribution Statement
- Drawing Revision.

The metadata that we observed in the .pvz file would be used by the Product Data Specialist to index the data for creation and storing in DLA's DMS. This file did not have all the metadata that DLA would like to accurately index and create the file in our DMS system, but would not prevent the file from being stored in our system.

To manufacture this part, the model provides the computer-aided manufacturing data necessary for construction. However, DLA did not consider this a complete technical data package since the technical information is missing as described above to finalize this part for placement into the field. AMRDEC agreed that a complete technical data would include the below information that DLA highlighted.

AMRDEC notified DLA that a complete data package would include a Separate Parts List (SPL), or other separate file, that would provide additional information that is required to build a complete technical data package and provide technical quality information. The additional information, that AMRDEC stated would be listed in the SPL or other file, that would be of interest to DLA would be the Bill of Materials, part notes on material requirements, tolerances, critical characteristics, and testing requirements.

This technical data would assist the Product Specialist to adequately monitor the part and for the Acquisition Specialist to develop a contract and evaluate offers from prospective manufacturers. As long as the data provided to DLA included a SPL and other files, with all the information mentioned above, the technical/quality and engineering functional areas of DLA would be satisfied with the technical data package.

In conclusion, DLA's ability to view the AMRDEC files using the Creo View Lite software was successful.

Conclusions

1. The Creo View viewer is not intuitive for new users. Without some training finding attributes and metadata is not intuitive.

2. No formal training or documentation could be found. LMI/ATI provided hands-on training during the pilot.

3. The Creo View viewer will take full advantage of the Creo View .pvz file format's capabilities. The amount of data, i.e. PMI, tolerances, metadata, that can be found in the .pvz file format is dependent on the ESA or OEM's modeling practices and standards. Not all related supporting metadata will be a part of the .pvz file itself and may be provided in an external source and/or a different file format.

4. The pilot demonstrated that the current technology (PTC's Windchill and associated modules) platform can be leverage by DLA for 3D viewing and interpretation; the focus needs to be shifted instead to processes (contractual language, standards etc.) and people (training, what is MBD, etc.).

5. Prior to moving forward with new software installations, the J6 EBS Production Support team must be involved to ensure the proper processes are followed and the software meets the IT requirements.

Appendix G
DLA Aviation JT Pilot

Introduction

This pilot validated that the DLA Aviation at Richmond can receive and view technical data in JT file format using the JT2Go viewer software and provided feedback to ensure that the technical data provided can meet the DLA sustainment needs.

LMI/ATI opted to pilot with DLA Aviation because of their high interest in being prepared to receive the JT file format from ESAs as their preferred technical data format and to view the file using the JT2Go viewer. Prior to this pilot, DLA Aviation had no experience with the use of technical data in JT format or the use of the JT2Go viewer software.

The pilot involved working with NSWCPD to obtain the technical data required for the pilot. The team worked with J6 EBS Production Support from Columbus to ensure the correct version of the JT2Go viewer was installed and met the government IT requirements. The team also worked with the DLA Aviation at Richmond to perform the validation.

Roles and Responsibilities

Validating the TDP required a series of steps that involved multiple stakeholders. The pilot team included representatives from the NSWCPD Technical Service Activity (TSA), J6 EBS Production Support, supply chain activities, and R&D contractors. Table G-1 summarizes the stakeholders and their roles.

Table G-1. Pilot Team and Roles

Organization	Role
LMI/ATI	Facilitator
NSWCPD	Technical Support Activity
J6 EBS Production Support	IT Support
DLA Aviation	Supply Center

Figure G-1 illustrates the workflow and responsibilities for the DLA Aviation JT pilot. The R&D contractor team was comprised of representatives from LMI and ATI. LMI/ATI facilitated the pilot, provided the technical data, trained on the use of the JT2Go viewer, reviewed deficiencies, identified and documented deficiencies, and collected and documented lessons learned.

For this pilot, NSWCPD provided the technical data in the JT file format. DLA Aviation was responsible for installing the JT2Go viewer, reviewing the TDP provided in JT file format, documenting and providing feedback on the use of the JT2Go viewer, reviewing the technical data to ensure they could perform their job function, and documenting the results and deficiencies.
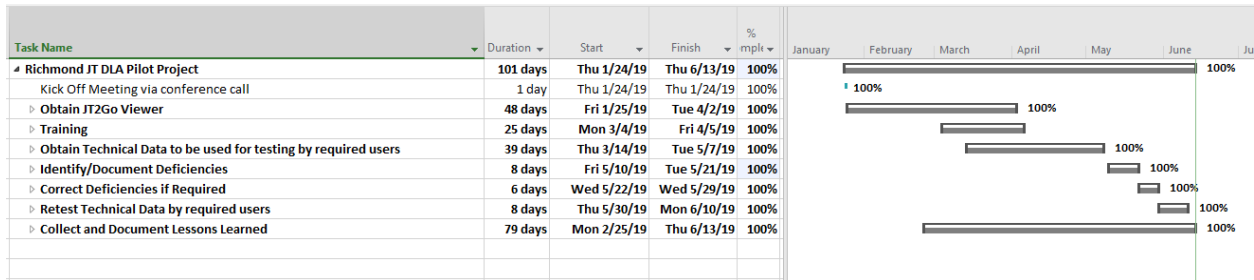
Figure G-1. DLA Aviation JT Pilot Process Workflow
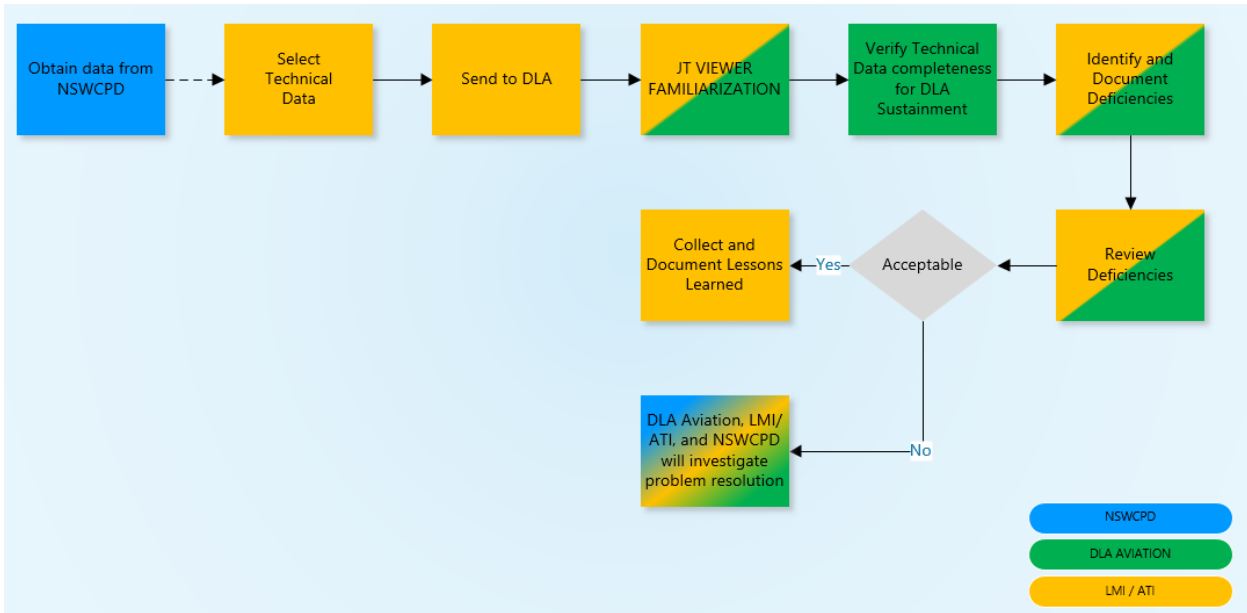
Schedule

The DLA Aviation JT pilot ran from January 24, 2019 through June 13, 2019. LMI/ATI documented process and technology feedback throughout the project. Figure G-2 shows the DLA Aviation JT Pilot schedule.

Figure G-2. DLA Aviation JT Pilot Schedule

Task Name	Duration	Start	Finish	% mplt
⊿ Richmond JT DLA Pilot Project	101 days	Thu 1/24/19	Thu 6/13/19	100%
Kick Off Meeting via conference call	1 day	Thu 1/24/19	Thu 1/24/19	100%
▷ Obtain JT2Go Viewer	48 days	Fri 1/25/19	Tue 4/2/19	100%
▷ Training	25 days	Mon 3/4/19	Fri 4/5/19	100%
▷ Obtain Technical Data to be used for testing by required users	39 days	Thu 3/14/19	Tue 5/7/19	100%
▷ Identify/Document Deficiencies	8 days	Fri 5/10/19	Tue 5/21/19	100%
▷ Correct Deficiencies if Required	6 days	Wed 5/22/19	Wed 5/29/19	100%
▷ Retest Technical Data by required users	8 days	Thu 5/30/19	Mon 6/10/19	100%
▷ Collect and Document Lessons Learned	79 days	Mon 2/25/19	Thu 6/13/19	100%

Candidate Part List

NSWCPD provided a training TDP so that users could familiarize themselves with the JT2Go viewer. NSWCPD also provided a test TDP to be used by engineering, technical quality and sustainment groups to ensure that the technical data provided was sufficient to perform their jobs. Table G-2 lists the part candidate info for both TDPs.

Table G-2. Candidate Part List for DLA Aviation JT Pilot

Part name	Part number
Piping Plumbing Missile Compartment Forward	LOA003313- R656-2301 Rev A
Logistic Escape Trunk Upper Hatch Operator Miscellaneous Details	LSA002848- R547-0251 Rev A

Pilot Summary

Based on our observations throughout the pilot and the feedback obtained from DLA Aviation entities within engineering, supply specialists, technical quality, and J6 EBS Production Support, our team gleaned several insights regarding the use of JT using the JT2Go viewer technology.

The members of the DLA Aviation JT pilot program conducted testing during the two weeks of April 15th through 26th. The consensus was that the users did not have any issues opening or viewing the data. The data appeared adequate for procurement from a technical/engineering perspective. The PDF file appeared to contain the data necessary for the product specialists, product data specialists, and engineers to produce the part. The data included a distribution statement, parts lists, and associated information for the assembly.

Some users expressed that the program was not as intuitive as other systems. For example, one of the users stated that he had trouble with some of the features such as the Find Part feature. However, it is anticipated that with more training or instruction that the features may be easier to use.

The J6 EBS Production Support team provided the following summary for their participation in the pilot. The JT2Go viewer was already approved for use on the DLA network. The J6 EBS team was asked to install and validate the technical capabilities of the JT2Go viewer from an IT perspective. The results of their testing showed JT2Go viewer was compatible with the DLA VDI network; however, some of the necessary files were not accessible. This viewer is used specifically for viewing JT files so the files that were not accessible did not affect the pilot. Once their testing was completed, the team provided access to those who would be performing the tests during the pilot.

Pilot Team Feedback

At the end of the DLA Aviation JT pilot, LMI/ATI requested a summary of the pilot from the perspective of our POCs at DLA Aviation. The purpose of having this summary was to obtain technology and process insights from their team to assess the overall feasibility of the technology tested, and to formulate lessons learned. The direct summary from our POCs at DLA Aviation is provided below:

- Technical Quality Team
  - I was able to see the PDF with all the required indexing information needed to load the data into DMS, and I was able to navigate the 3D Model data. This allows us to be able to perform our job function within the technical quality group.

- Engineering Team
  - I did not have any issues in opening or viewing the data using the JT2Go viewer. There appeared to be good engineering data present for building the part. The PDF file includes all of the other items that are needed by the Product Specialists, Product Data Specialists and Engineers for producing the part. The distribution statement, parts lists and associated information for the assembly were also available. I did however have trouble using some of the features such as the Find Part, but it may be more of a matter with my familiarity. Also, I was confused when I tried to click on some of the items and nothing showed up as far as extra information but I was advised by ATI that this is what should have happened.
- Product Specialist
  - I can view the 3D models, as well as review the PDF file. This allows me to be able to perform my job function within the Supply Specialist group.

Conclusions

Based on the documentation and results of the DLA Aviation JT pilot, LMI/ATI drew the following conclusions:

1. The JT2Go viewer software is a valid option for viewing a JT file format. The viewer allows the users at DLA Aviation to view and find data required to perform engineering functions, technical quality functions, and Product Specialist functions.

2. Upfront training would better prepare them to easily find necessary parts of the technical data such as viewstates, certain metadata, and part attributes.

3. The JT2Go viewer will take full advantage of the JT file format's capabilities. The amount of data, i.e., PMI, tolerances, metadata, that can be found in the JT file format is dependent on the ESA or OEM's modeling practices and standards. Not all related supporting metadata will be a part of the JT file itself and may be provided in an external source and/or a different file format.

4. Prior to moving forward with new software installations, the J6 EBS Production Support team must be involved to ensure the proper process are followed and the software meets the IT requirements.

Appendix H
Defense Contract Management Agency JT Pilot

Introduction

The objective of this pilot was to validate that the DCMA can receive and view technical data in JT file format using the JT2Go viewer software and provide feedback to ensure that the technical data provided can meet the DCMA inspection and surveillance needs.

LMI/ATI opted to pilot with DCMA because of their high interest in being prepared to receive the JT file format from various organizations as their preferred technical data format and to view the file using the JT2Go viewer. Prior to this pilot DCMA had no experience with the use of technical data in JT format or the use of the JT2Go viewer software.

The pilot involved working with NSWCPD to obtain the technical data required for the pilot. The team also worked with the DCMA engineering and technical quality groups to perform the validation.

Roles and Responsibilities

Validating the TDP required a series of steps across multiple stakeholders. The pilot team included representatives from the NSWCPD Technical Service Activity (TSA), DCMA engineering and technical quality groups, and R&D contractors. Table H-1 summarizes the stakeholders and their roles.

Table H-1. Pilot Team and Roles

Organization	Role
LMI/ATI	Facilitator
NSWCPD	Technical Support Activity
DCMA	Inspection & Surveillance

Figure H-1 illustrates the workflow and responsibilities for the DCMA JT pilot. The R&D contractor team was comprised of representatives from LMI and ATI. LMI/ATI's primary responsibilities included facilitating the pilot, providing the technical data, training on the use of the JT2Go viewer, reviewing deficiencies, identifying and documenting deficiencies, and collecting and documenting lessons learned.

For this pilot, NSWCPD provided the technical data in the JT file format.

Finally, DCMA was responsible for installing the JT2Go viewer, reviewing the technical data package provided in JT file format, documenting and providing feedback on the use of the JT2Go viewer, reviewing the technical data to ensure they could perform their job function and document the results and deficiencies.

Figure H-1. DCMA JT Pilot Process Workflow
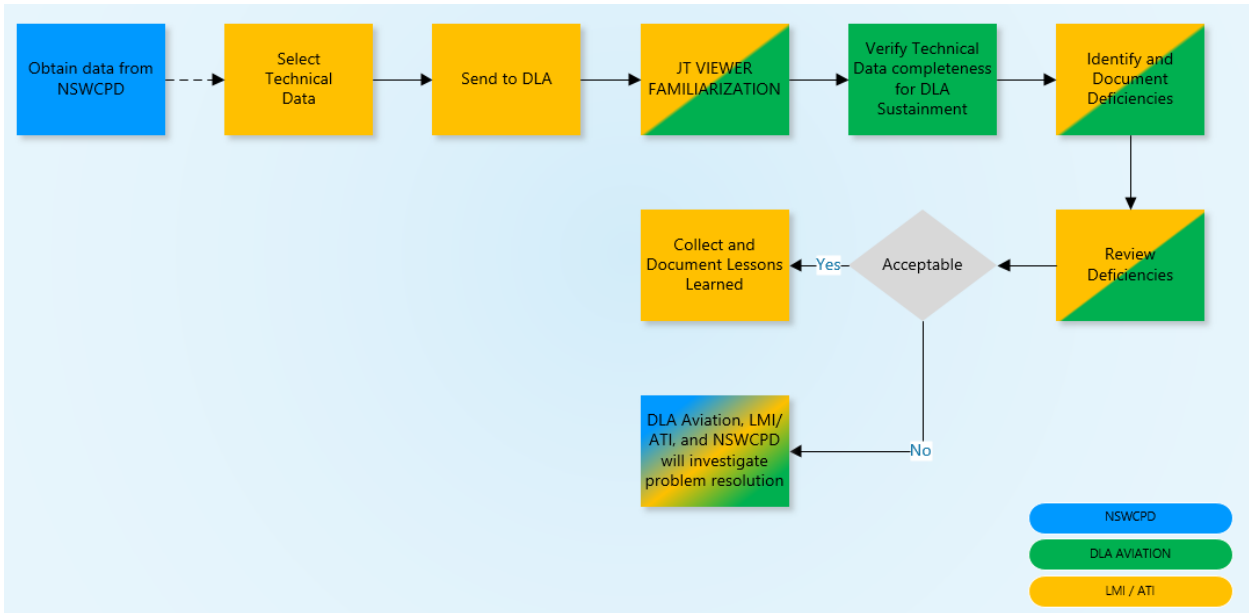
Schedule

The DCMA pilot ran from January 2019 through July 2019. The pilot kickoff meeting took place on January 29, 2019. Pilot completed by July 19, 2019. LMI/ATI documented process and technology feedback through the duration of the project. Figure H-2 shows the DCMA JT Pilot Schedule.

Figure H-2. DCMA JT Pilot Schedule

Task Name	Duration	Start	Finish	% mple
◢ DCMA JT DLA Pilot Project	146 days	Tue 1/29/19	Tue 8/20/19	100%
Kick Off Meeting via conference call	1 day	Tue 1/29/19	Tue 1/29/19	100%
▷ Obtain AutoCAD Software	50 days	Mon 4/8/19	Fri 6/14/19	100%
▷ Obtain JT2Go Viewer	109 days	Tue 1/29/19	Fri 6/28/19	100%
▷ Training	78 days	Wed 3/20/19	Fri 7/5/19	100%
▷ Obtain Technical Data to be used for testing by required users	87 days	Wed 3/20/19	Thu 7/18/19	100%
▷ Identify/Document Deficiencies	8 days	Fri 7/19/19	Tue 7/30/19	100%
▷ Correct Deficiencies if Required	4 days	Wed 7/31/19	Mon 8/5/19	100%
▷ Retest Technical Data by required users	7 days	Tue 8/6/19	Wed 8/14/19	100%
▷ Collect and Document Lessons Learned	32 days	Mon 7/8/19	Tue 8/20/19	100%

Candidate Part List

NSWCPD provided a training TDP so that users could familiarize themselves with the JT2Go viewer. NSWCPD also provided a test TDP to be used by engineering and technical quality groups to ensure that the technical data provided was sufficient to perform their jobs. Table H-2 lists the part candidate info for both TDPs.

Table H-2. Candidate Part List for DCMA JT Pilot

Part name	Part number
Piping Plumbing Missile Compartment Forward	LOA003313- R656-2301 Rev A
Logistic Escape Trunk Upper Hatch Operator Miscellaneous Details	LSA002848- R547-0251 Rev A

Pilot Summary

LMI/ATI conducted a pilot with DCMA to validate whether they could receive and view JT files using the JT2Go viewer software. LMI/ATI worked with NSWCPD to obtain the technical data required for testing. NSWCPD provided two technical data sets, one to be used as a training guide (Piping Plumbing Missile Compartment) and the other for actual testing (Forward and Logistic Escape Trunk Upper Hatch Operator). DCMA provided LMI/ATI with documentation of their experience with JT files and the use of the JT2G0 viewer.

In its summary of the pilot, DCMA stated the users had issues opening the JT file using the link in the PDF file. The data appeared adequate for DCMA to perform quality checks and surveillance. The team was able to access from the PDF file required information such as technical requirements, part JT Surface data files, assembly/manufacturing notes, engineering parts list, material comments, and detailed drawings, including all dimensions and tolerances.

DCMA did conclude that the TDP was adequate for their use but the value of using the PDF in JT2GO in lieu of Adobe Acrobat is questionable. The additional solid model manipulation provided by JT2GO has little perceived value to DCMA. At the current time, JT2GO does not offer any additional required capabilities for DCMA that is not found in the PDF TDP.

DCMA provided a gap assessment of the technology. A definitive job aid (or potential training) would be required to equip the DCMA field personnel to use JT2GO.

LMI/ATI observed that the IT testing requirements and obtaining a certificate of networthiness are imperative prior to installing any new software on the DCMA network. The lead time for this action could take weeks or months. It is important that the IT department be notified and involved early in the process to ensure there are no delays.

Pilot Team Feedback

At the end of the DCMA JT pilot, LMI/ATI requested a summary of the pilot from the perspective of our POCs at DCMA. The purpose of having this summary was to obtain technology and process insights from their team to assess the overall feasibility of the technology tested, and to formulate lessons learned. The direct summary from our POCs at DCMA is provided below.

Visibility of TDPs created with the embedded JT models and drawings via Adobe Acrobat (or an alternative, DCMA-IT approved viewer, like JT2GO) will enhance DCMA's ability to provide technical oversight on contracts.

DLA's contractor for the project, LMI/ATI, provided a technical data packages for training, LOA003313- R656-2301 Rev A and LSA002548_A_R547-0251 Rev A for evaluation. Testing of Siemen's JT2GO software by IT security was required prior to installing on the DCMA network. This was not possible during the pilot timeframe due to higher priorities within the DCMA IT department. Hence, the software was installed on two isolated computers for this evaluation.

One tester was readily able to identify needed information on the embedded models in the PDF and, with minimal trials, able to obtain dimensions from the JT models. The other engineer was unable to consistently perform basic operations. For example, the system defaulted to metric values and, when converted to imperial values, the measured values did not correspond to drawing dimensions. Neither tester was able to get the PDF file to open the model directly into JT2GO. The 'Launch JT2GO' link in the PDF would not launch the JT2GO Software even with JT2GO already running. The pages in the PDF switch back and forth between portrait and landscape page orientations. This will cause difficulties when printing the documentation.

Opening the PDF in Adobe Acrobat would allow access to the information within the file (technical requirements, including bill of materials, tolerances, drawings and part JT Surface data files). The PDF format also contains data distribution information, date, page, and configuration identification. The models were for parts for the COLUMBIA class submarine and the PDF data package did not include the Sub Safe requirements (i.e., detailed documentation required from foundry to final machining).

Within the PDF document (whether opened in Acrobat or JT2GO) the testers were able to explore all 36 pages, and to assess assembly/manufacturing notes, engineering parts list, material comments, and detailed drawings, including all dimensions and tolerances. JT2GO simply added to the expanse of data that could be viewed by providing additional measurement tools that could be applied to the JT model in any drawing view and the ability to manipulate the model (sizing, rotation, etc.).

Recommendation

A definitive job aid (or potential training) would be required to equip the DCMA field personnel to use JT2GO.

Conclusions

DCMA field personnel can adequately use this PDF package assessed via Adobe Acrobat (with the addition of the Navy Sub-Safe foundry to final machining documentation requirement) for Government Contract Quality Assurance requirements. The value of using the PDF in JT2GO in lieu of Adobe Acrobat is questionable. The additional solid model manipulation provided by JT2GO has little perceived value to DCMA. At the current time, JT2GO does not offer any additional required capabilities for DCMA that is not found in the PDF TDP.

Appendix I
Abbreviations

2D	two-dimensional
3D	three-dimensional
3Di PDF	Three-Dimensional Intuitive Product Document Format
ADM	advanced design manufacturing
AFB	Air Force Base
ATI	Advanced Technology International
AMRDEC	Aviation and Missile Research, Development and Engineering Center
API	application programming interface
APL	allowance parts list
ARDEC	Armament Research, Development and Engineering Center
AVN	Aviation
CAD	computer-aided design
CAGE	Commercial and Government Entity
CAM	computer-aided manufacturing
CIO	chief information officer
CON	Certificate of Networthiness
CONOPS	concept of operations
DCMA	Defense Contract Management Agency
DE	design element
DEMIL	demilitarization
DES	digital engineering strategy
DIBBS	DLA Internet Bid Board System
DLA	Defense Logistics Agency
DLIS	Defense Logistics Information Service
DMS	document management system
DoD	Department of Defense
DWG	drawing
DXF	Drawing Exchange Format
EB	Electric Boat
EBOM	engineering bill of materials

EBS	Enterprise Business Systems
ECAT	electronic catalog
ECBC	Edgewood Chemical Biological Center
EDFP	Electronic Data for Provisioning
EPL	engineering parts list
ERP	enterprise resource planning
ESA	engineering support activity
EWA	Enhanced Wing Assembly
FLIS	Federal Logistics Information Services
FPW Mod	FLIS Portfolio Workbench Provisioning Model
GD&T	geometric dimensioning and tolerancing
HTML5	Hypertext Markup Language revision 5
ICAPS	Interactive Computer-Aided Provisioning System
IGES	initial graphics exchange specification
IT	information technology
JEDMICS	Joint Engineering Management Information and Control System
JT	Jupiter Tessellation
L&M	Land & Maritime
LET	Logistics Escape Trunk
LIS	Logistics Information Services
ManTech	Manufacturing Technology
MBD	model-based definition
MBE	model-based enterprise
NAVAIR	Naval Air Systems Command
NAVSUP	Naval Supply Systems Command
NIIN	National Item Identification Number
NNS	Newport News Shipbuilding
NSN	National Stock Number
NSRDEC	Natick Soldier Research, Development and Engineering Center
NSWCPD	Naval Surface Warfare Center Philadelphia Division
OEM	original equipment manufacturer
PDF	Portable Document Format
PdM SKOT	Product Manager, Sets, Kits, Outfits, and Tools
PLM	product life-cycle management

PMI	product and manufacturing information
PMO	program management office
POC	point of contact
R&D	research and development
REV	revision
RNCC/VC	Reference Number Category Code/Variation Code
SAFE	Secure Access File Exchange
SPR	SOLIDWORKS Performance Reports
SR	service request
SSR	supply support request
STEP	Standard for the Exchange of Product Model Data
STL	Standard Triangle Language
TACOM	Tank-automotive and Armaments Command
TARDEC	Tank Automotive Research, Development and Engineering Center
TD	technical data
TDP	technical data package
TS	Troop Support
TSA	Technical Solution Authority
U3D	universal three-dimensional
VDI	Virtual Desktop Infrastructure
WSS	Weapon Systems Support

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