Technical Order Conversion to S1000D – Management Lessons Learned from the C-17

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Introduction

- Pre-conversion environment
- What's in the contract
- Lessons learned we incorporated into the program thinking
- Where we are today
- Things we learned along the way

C-17 paper ecosystem

- 1980s air vehicle engineering design with DOD-STD-863B refdes breakdown
- LSA initially developed but no longer deliverable
- C-17 SNS based on DOD-STD-863B / MIL-M-83495
- 1970s/80s TO Military Standards extensively tailored
- TOs sustained by Boeing since first delivery
- Tables presentation of Fault Isolation data

- Aircraft identity within TOs defined by two character code vice tail number
- Early prototype Mil-Std SGML -> OmniMark -> XPP -> Tagged PDF and Paper
- Single source CSDB for USAF and FMS unique content
- Under PBL sustainment contract Boeing is the Technical Content Manager

C-17 S1000D timeline - we had a dream

- 2001 – Air Mobility Command (AMC) requests a Mil-Std IETM estimate
  - AMC eTools and distribution infrastructure plan placed into motion
  - Unfunded Priority for conversion deferred to future years
- 2004 – Boeing begins investments for C-17 S1000D conversion:
  - Air Force policy encouragement
  - Performance Based Logistics (PBL) enabler
- Feb 2008 – AMC requests an IETM Industry Day to understand:
  - US and International Commercial/Military commitments to S1000D
  - Boeing and C-17 Program commitments to S1000D
- Jul 2008 – USAF S1000D Working Group Kick-Off meeting
- May 2009 – FedBizOps released a C-17 S1000D conversion market survey request
- Dec 2010 – Contract awarded for C-17 S1000D conversion
- Apr 2011 – Issue 3.0 data set delivered for paper to digital verification
- Apr 2012 – Issue 4.0.1 data set delivery begins

Why S1000D?

Mil-Spec Paper Tech Pubs
- **Familiar**
- **Paid off**

Full-Up Mil-Spec IETM
- **All the bells and whistles**
- **Budget buster**

S1000D
- **More robust than paper**
- **Less expensive with trade-in**

What we offered

- Use of the existing paper delivery SGML database of verified technical data and illustrations as transformed by Boeing's existing transformation tools
- S1000D output synchronized to paper output based on single source CSDB
- Use of a step/milestone approach to conversion and verification:
  - Open conversion source code to USAF inspection to build confidence
  - Boeing Business Rules Issue 3.0 XML delivery to "mirror" paper PDF (paper -> digital)
    - No illustration creation or illustration hot-spotting
    - USAF verification of no paper to digital loss of data [frozen data snapshot]
    - Conversion related issue resolution responsibility of Boeing
  - USAF Business Rules Issue 4.0.1 XML (digital -> digital)
    - New schema naming applied along with improved 4.0.1 functionality
    - TO Number referencing links updated to DMC numbering display
    - IPD hot-spotting
    - Tail number filtering using USAF Maintenance System configuration data
    - USAF verification of Issue 4.0.1 functionality
- Risk contained at each level of milestone delivery without compromising the final deliverable or day-to-day sustainment of paper

1st Step: Paper data to digital data conversion

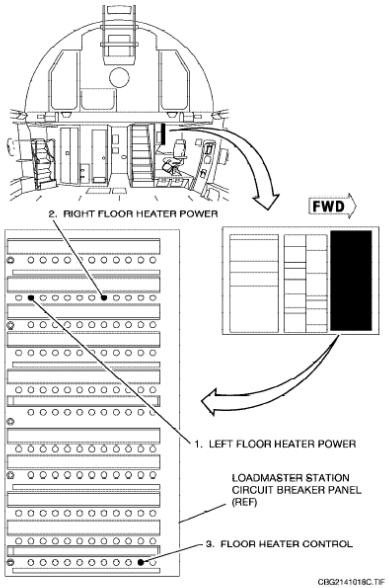
TO 1C-17A-2-21JG-40-1

3-2. FOLLOW-ON MAINTENANCE.

1. Remove warning tag and close **LEFT FLOOR HEATER POWER** circuit breaker on loadmaster station circuit breaker panel, row **B**, column **2**.
2. Remove warning tag and close **RIGHT FLOOR HEATER POWER** circuit breaker on loadmaster station circuit breaker panel, row **B**, column **8**.
3. Remove warning tag and close **FLOOR HEATER CONTROL** circuit breaker on loadmaster station circuit breaker panel, row **L**, column **11**.

21-41-11-3
2-50

TO 1C-17A-2-21JG-40-1



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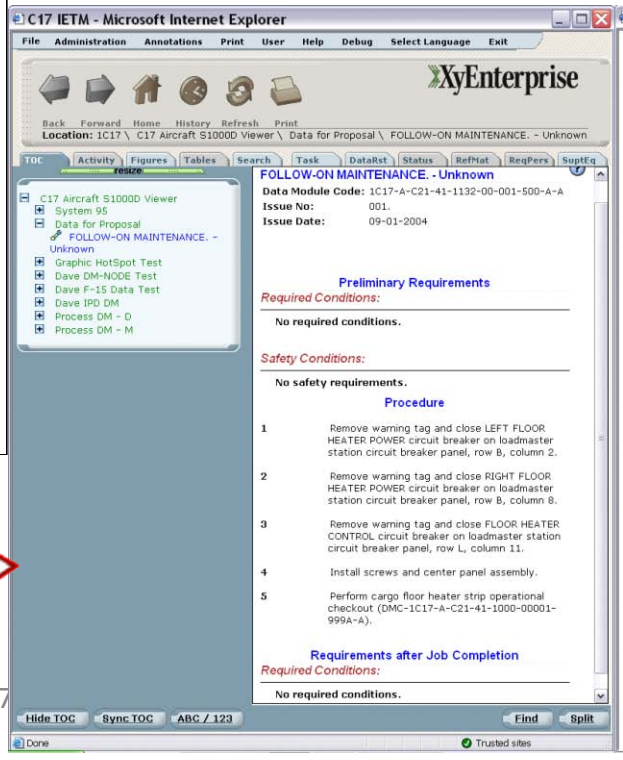
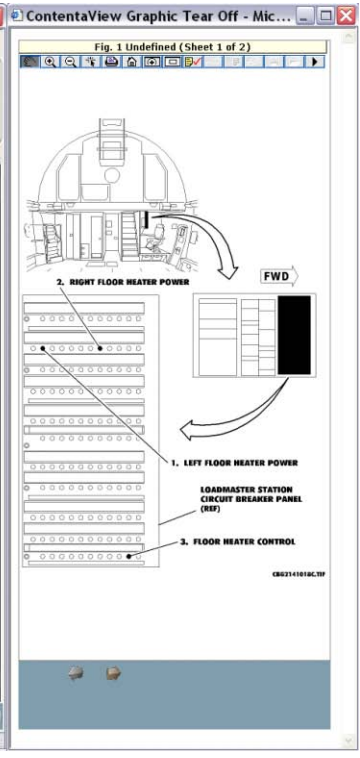
No loss of verified content

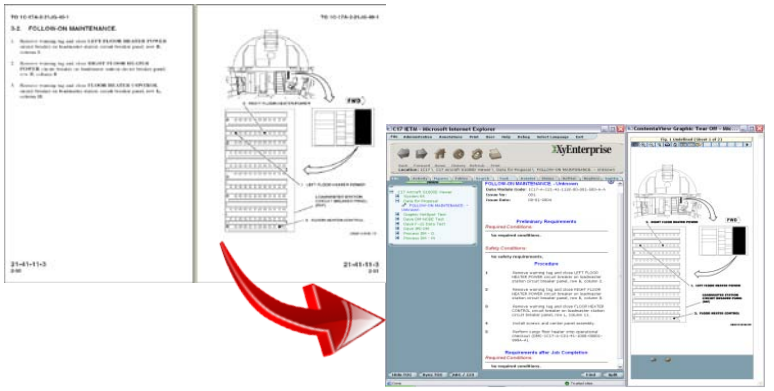


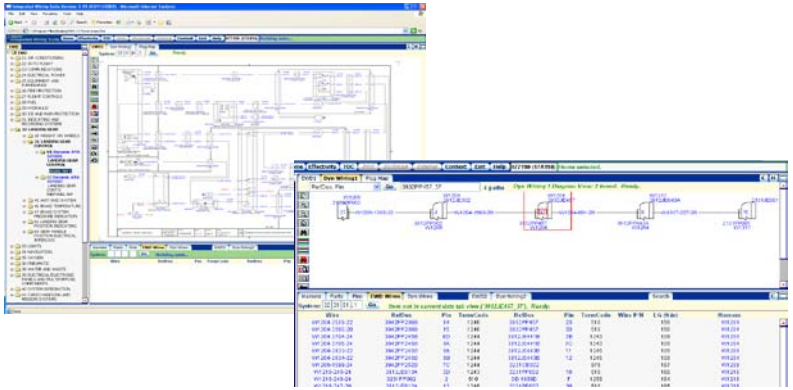


S1000D

Contracting framework

- Pilot program for USAF
  - Draft USAF Business Rules applied
- Boeing S1000D datamodules licensed
- Incorporates IETM lessons learned
- Utilize SGML CSDB for live source
- Step approach to verification
- Use USAF designated viewer
- Includes Boeing wiring tools
- Current Status:
  - Issue 3.0 data verification – 100% complete
  - Deliver Issue 4.0 data functionality – Apr - Jun 2012
  - Scheduled USAF field user evaluation – late 2012





What's in and out for the conversion

- Books included in S1000D conversion:
  - Job Guides
  - Fault Isolation
  - General Systems
  - Illustrated Parts Breakdown
  - Inspection Workcards
  - Structures, NDI, Corrosion, Miscellaneous
- Books not included in the conversion:
  - Flight and Loading manuals
  - Wiring diagrams [optioned licensing of existing Boeing wiring tool]
  - Schematics
  - Support Equipment
  - Intermediate Level
  - Aircraft Battle Damage Repair

Ground Rules and Assumptions

- No changes to aircraft required (no AME/ALE)
- USAF certifies software for use on their systems
- Contractor provides licenses for the specified IETM viewer
- Contractor provides proprietary wiring tool
- G081 is primary source of current aircraft configuration data
- AMC provides the finalized Air Force level IETM Business Rules to be enforced in the transformed data
- USAF infrastructure and eTools in-place to handle S1000D at time of delivery
- USAF provides a capability to verify that the transformation of data does not change tasks or data as currently described with the existing TOs
- Contractor provides initial familiarization training on the S1000D specification and the browser to Air Force users.

Previous Customer(s) views – Lessons Utilized

- Need full-time military and contractor Program Managers
- Early on effort to approve tools for IT infrastructure
- Sustaining two CSDBs is costly
- Cleaning data in the transform CSDB is costly, fix in the paper CSDB
- Define what is going to remain in paper [2-1, Wiring Diagrams, Schematics, inspection cards, engine run checklists, etc.]
- Validate eTool viability for engine runs [need solid state HDD?]
- Plan adequate reserves on customer side for scope growth [policy and functionality changes]
- Lock down the elements being transformed and new required elements in a specification interpretation document (SID) or the Business Rules
- Business Rules must be developed at multiple levels down to the specific aircraft and potentially the aircraft operator

Previous Customer(s) views– Lessons Utilized (cont'd)

- Continue to fund the paper deliveries until you have a final approved product for use by the field
- Involve the training community at the beginning of the process for continuing training
- Avoid separating the current content authors from the conversion team
- Identify, plan, and budget for the customer staff to support the program
- Identify the IETM verification plan prior to contracting for the IETM
- Provide a full-up disconnected mode capability
- Provide ability to filter technical data by tail number and completed TCTO
- Provide a capability to print out a procedure

Boeing View – Lessons Utilized

- Verification of paper to digital is difficult to do if content display is changed
- Proprietary AME/ALE bundling adds complexity – just the data
- Make sure the data is S1000D viewer agnostic - all data valid and well formed
- Have the Customer define the target viewer – keep contract focus on the data
- Keep all related technical data on one device (S1000D viewer, PDF, and Wiring)
- Link the S1000D data to referenced PDF books and external wiring tools
- Establish user focal groups early on to test the usability of the data and viewer
- Minimize user clicking to retrieve data by reducing data layers where feasible
- Ensure rapid partial data delivery (PDD) update data delivery for USAF distribution
- Provide a robust search capability

Boeing View – Lessons Utilized (cont'd 2 of 3)

- Display all steps with a legacy step number step number – facilitate verification, enable use of existing illustrations
- Allow display/printing of -6 Type Scheduled Inspection / Replacement criteria
- Retain an ability to go back to paper if required
- Use a common risk management system with the customer
- Utilize Decision Records signed by the USAF and Boeing program managers and military user focals when areas of contract/scope interpretation reach consensus between all technical parties
- Use a common formal action item tracking system
- Share data and conversion discrepancies using common tools like SharePoint
- Imbed information expeditors at the customer's verification location
- Third party verification of conversion script quality reduces risk to both sides

Boeing View – Lessons Utilized (cont'd 3 of 3)

- Utilize AFTO Forms 27 to document verification of each converted book
- Keep customer informed on the progress of source data corrections on the sustainment contract
- Save all the extra IETM improvement possibilities for post-conversion sustainment

C-17 pages converted to data modules

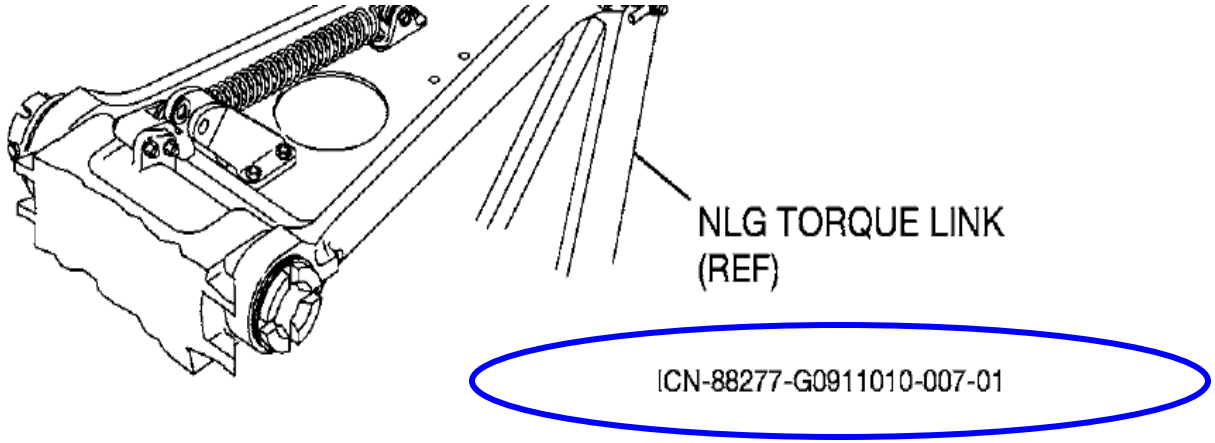
Technical Order Type	# Pages	# Data Modules
Illustrated Parts Breakdown (IPB)	32,040	3,844
Job Guide (JG)	89,320	16,749
Fault Isolation (FI)	10,220	7,702
General Systems (GS)	7,726	1,519
Structure Repair (SR)	13,064	4,484
Miscellaneous	15,247	5,607
Total*	167,617	39,905

S1000D

***NOTE: Wiring Diagrams not converted to S1000D**

C-17 Illustrations converted to approved format

- 58,611 legacy graphics for the paper books being converted
- All graphics updated with ICN board numbers
- All graphics delivered as full vector WebCGM 2.0
- 12,493 IPD specific graphics hot-spotted for index callouts
- No new illustrations created



What we learned along the way

- Our SGML DTDs were too flexible, writers are creative
  - We needed to create new SGML checker tools to reduce variability
  - We needed to tweak our SGML DTDs for tighter rule enforcement
  - Reducing writer variables reduced rework for both paper and digital
- XML provides better cross checking of matching data (or lack of match)
  - We improved the quality of our paper and digital products
- How applicability was handled within the SGML could be improved
- In the paper world, we were driven to non-optimal SGML tagging methods to force paper output expectations that had to be undone (ex: placement of warnings, caution and notes within para tags)
- Switching to the ICN format for our paper based illustration board numbers reduced potential conversion work/issues

Summary

- Supported a long term commitment to a digital environment
- Made use of the customer's verified data investment
- Incorporated lessons learned
- Leveraged programmer skills to reduce key punching
- Focused on making the verification as easy as possible
- Separated bells and whistles from content conversion
- Improved our core source data along the way
- Involved the end user maintainer early in the process to improve buy-in
- Measurement of our success to be verified in late 2012 during user testing

Questions?

Speaker Bio

Bob Behrens is currently Senior Manager of C-17 Technical Data and Training for the Boeing C-17 Program.

He has overall responsibility for the sustainment of technical publications used by the United States Air Force and several foreign air forces in the day-to-day maintenance of the C-17 airlifter. He has held a number of leadership positions within the C-17 product support environment including field service and supply chain management since joining the company in 1989.

Before joining Boeing, Behrens served over twenty-one years in the United States Air Force in a variety of aircraft maintenance and flight related positions and retired in the grade of Chief Master Sergeant.

Behrens holds a bachelor's degree in business management from the University of New York and a master's degree in from Argosy University in international trade.

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