Effectively Using Digital Information and Tools to Revolutionize Maintenance and Sustainment

24 March 2016

Presented by:
Mr. Gary Steffes
AFRL/RQVS
937-656-8754
Gary.steffes.1@us.af.mil

DISTRIBUTION STATEMENT A. Distribution approved for public release. Case number 88ABW-2016-0882.

Co-Contributors

- AFRL – Stephan Wolanczyk (RQ), Charles Buynak (RX), Edward White (RX), Chantale Wilson (RH)
- AFMC
  - AFSC - David Campbell (EN), Heath Burnett, Shawn Stieber, Mark Scott, Thomas Smallwood, Richard Duin (76 AMXG)
  - AFLCMC – Robert Pilarczyk, Hazen Sedgwick, Jeff Howell (A-10 SPO), Jacob Warner (F-22 SPO), Mark Rudolph, Isaac Van Cleave, Clay Risley, Kim Payne (B-52 SPO), Alvin Graul (AGE)
- AETC – Tracey Cain, Patrick Gilbert (982 LGMS)
- Contractors
  - Thomas Sharp (Etegent)
  - Carlos Pairazaman, James MacInnes, George Nuxoll (Uniwest)
  - Michael Craft, Bryan Harris (UDRI)
  - Michael Johnson (Aunautics)
  - David Kidder (Siemens)

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Outline

- Introduction
- Data loss in sustainment
- Approach to finding resolutions
- Examples
  - Point of Discovery Data Collection
  - Ground Support Equipment
  - Visualization Tools
  - Training and Tech Data Improvements
- Connection to Engineering
- Summary

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Introduction

- Background
  - Lots of emphasis on developing software tools to improve A/C sustainment
  - Much of that focus has been on developing tools for engineers (Product Lifecycle Management (PLM), databases, analysis tools, realtime capabilities, etc.)
  - At times, Maintenance (Mx) community can be left out
- Motivation
  - Mx communities need enhanced software tools
  - AFRL Sustainment Office sponsoring projects that address many needs in this area

IT'S THE MX COMMUNITY THAT COLLECTS MOST OF THE DATA TO FEED ENGINEERING DECISIONS

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Issues

- Tools just as antiquated as the aircraft themselves
  - Support equipment was developed with the aircraft
  - Lack of software understanding
- Software systems very limited
  - Schedule driven philosophy is not conducive to data collection
  - Need for instant results drives creation of individual excel spreadsheets
- Mx is a complex environment
  - Aircraft touches all skills

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Data Loss in Sustainment Processes

Aircraft Structural Knowledge

Specific Tail Number:
- Configuration
- Part State
  - Crack
  - Oversize holes
  - Etc.
- Flight Data
- Flight Events

Airframe
- Test and Teardown
- Load Data
- Mission Profiles
- Historical Analysis

Decision making Uncertainty ????

Structural engineering analysis
- Analysis tools not linked
- Reporting delays
- Unorganized/stovepiped data

Engineering data
- Ad-hoc data storage
- Ineffective data archive/retrieval system

Request engineering assistance
- Incomplete/Incorrect documentation

Repair within allowable limits
- Undocumented maintenance actions
- Maintenance induced damage

Maintenance
- Induced damage
- Inadequate training/tech data

Inspection Findings
- Raw data not saved
- Defect size below threshold
- Incomplete/incorrect documentation

Measurement
- Below detection threshold
- Limited data outputs

Manufacture
- Rework
- MRB
- Dispositions

Distribution Statement A: Distribution approved for public release. Case number 88ABW-2016-0882.

Approach to Find Solutions

- Plug the data leaks
  - Efficient data collection capabilities
  - Common tools across sustainment
  - Centralized data accessibility
- Improved training and tech data
- Enhanced analysis tools
- Better linkages between Mx and engineering

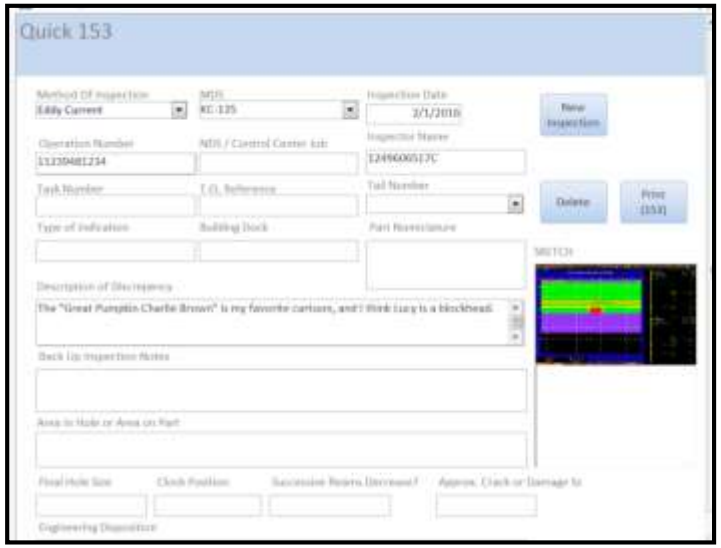
Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

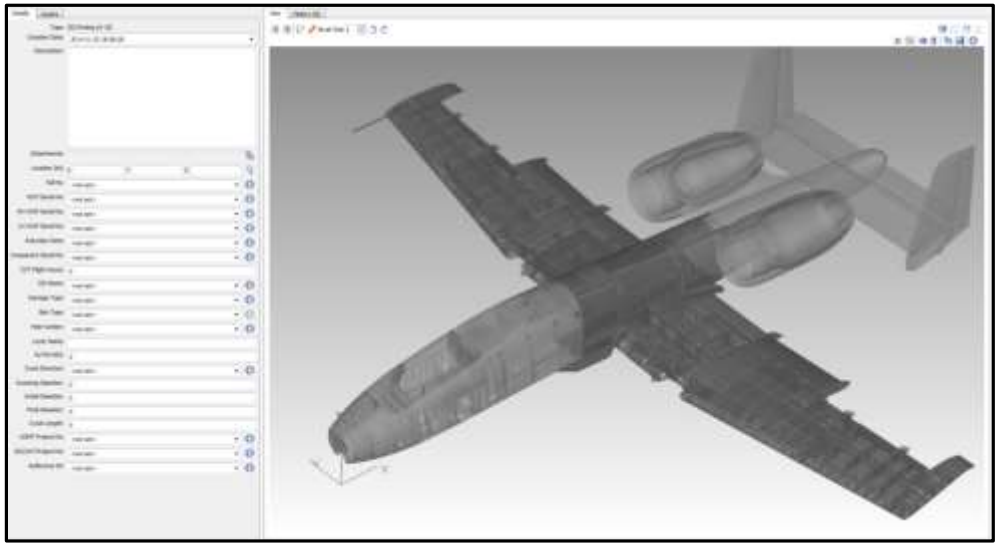
Efficient Data Collection

- Developed in concert with AFRL/RX
- Electronic data capture at Point of Discovery
  - Replace manual paper based methods
  - Easily route data between various groups
- Portable tablet based
  - Network approved systems
  - CAC enabled
  - Contain Tech Orders
- Features
  - Collect photos and test data
  - Prepopulated forms
  - Drop down selections (standardize inputs)

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Electronic Data Collection Systems





Photographs showing different data collection systems being developed by the AFRL Sustainment Office

- Long term strategic directions
  - Link to Maintenance, Repair, Overhaul (MRO) systems
    - Maintain currency of prepopulated forms
    - Triggers next job
  - Link to Engineering Disposition systems

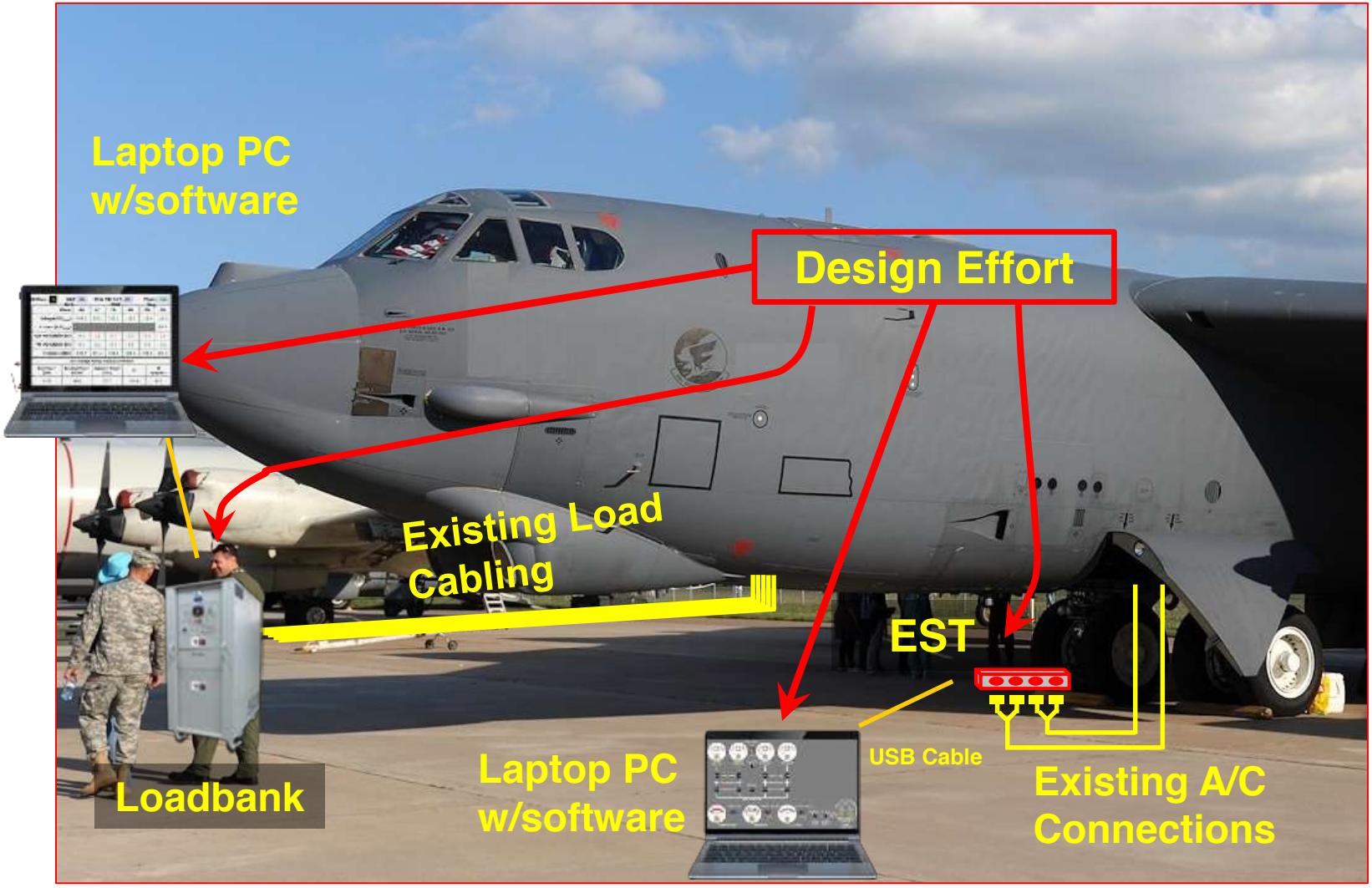
Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Aerospace Ground Equipment (AGE)

- Sustainment needs for aircraft avionics/electrics systems
  - Aircraft may have several modifications to the electronics/avionics systems in the past
  - Testing requirements during maintenance
    - Verify functionality
    - The sustainment of AGE can be overlooked
    - AGE systems can become unsupportable
- The AFRL Sustainment Office has joined with AFRL/RX to redesign portable testing systems
  - B-52 Electrical Systems Testers

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

B-52 Electrical Systems Testers



Schematic showing Loadbank and Electrical Systems Tester (EST) test setup

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Universal Software Controller

- Develop a universal software controller that drives several testing systems
  - Government owned software
  - Software recognizes hardware and configures GUI accordingly
  - Open extensible architecture
    - Enables SMXG or contractors to integrate with software
    - Provide short term licenses to vendors for new hardware
- Benefits
  - Minimizes TO rewrites
  - Enables better long term supportability
  - Reduces cost

Same Software: Auto - configurated GUIs for different hardware

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Universal Software Controller

- AGE is deployed on an AF-wide basis
- Issue: Ensure current version of software is used
  - Control hardware
  - Collect data
- Long Term Vision - Utilize Cloud Computing services
  - Software as a Service (SaaS)
    - Software exists in the cloud and is downloaded to cloud clients when avionics/electrical tests are run
    - Software application doesn't exist on individual computers at base level
  - Benefits
    - Centralized hosting of software application
    - Users can be added and removed easily

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Visualization Tools

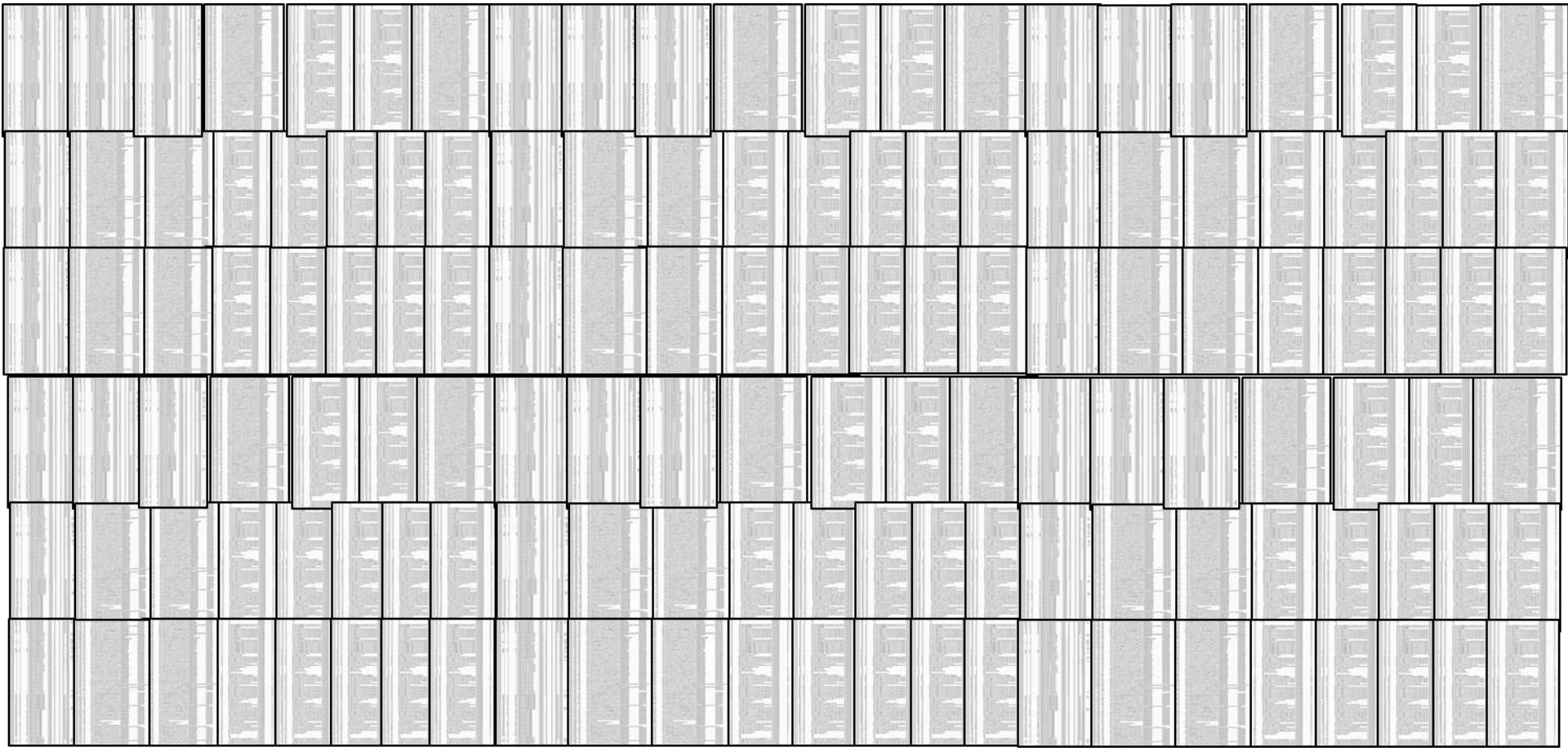
- Developing visualization tools to help maintainers and engineers
  - Adapt visual tools using NLign software
  - All levels of maintenance could benefit from common accredited platform

- Speed in Maintenance – Quick Data Searches
  - Planners
    - Track individual A/C configuration
    - Known historical maintenance data
    - Reduced the 'unexpected' upon A/C induction
  - Mechanics
    - Record TO and TCTO findings
  - NDI
    - Inspection data collection

Distribution Statement A: Distribution approved for public release. Case number 88ABW-2016-0882.

Data Search Capability w/NLign

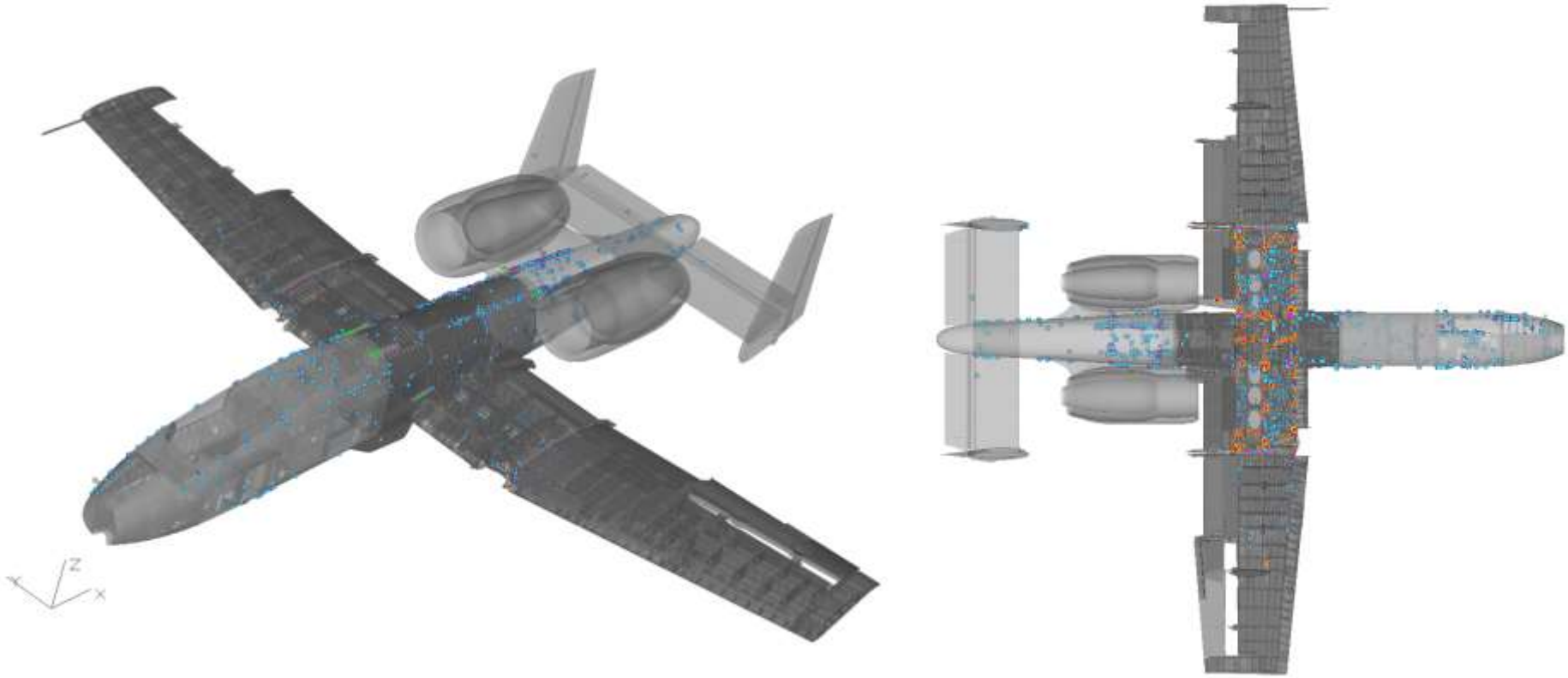
- ‘Clean’ written communication enables quick searching
  - Historical document searching (Days to minutes)



Distribution Statement A: Distribution approved for public release. Case number 88ABW-2016-0882.

Data Search Capability w/NLign

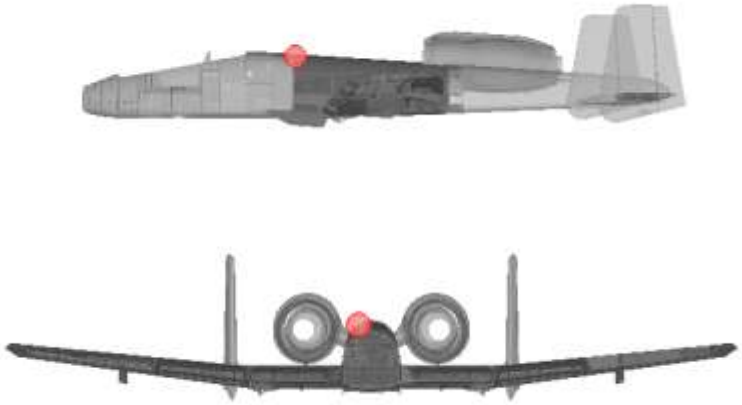
- **Same ‘clean’ data but represented in a visual form**



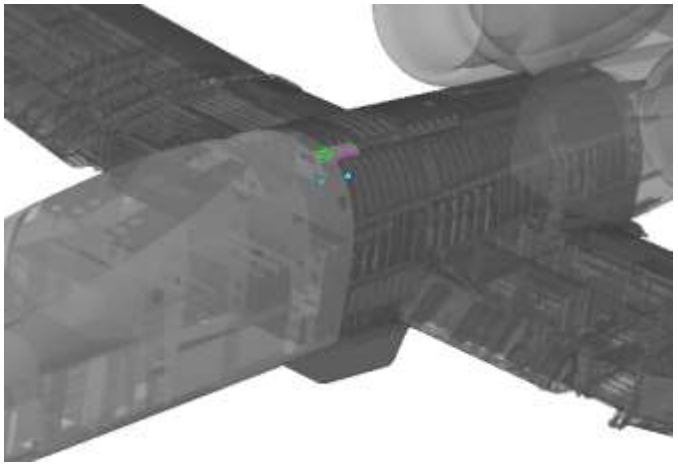
Distribution Statement A: Distribution approved for public release. Case number 88ABW-2016-0882.

Data Search Capability w/NLign

- **Customizable searching**
  - **Filter based on types of data (i.e. serialized assets)**
  - **Location**
  - **Combination trending**
  - **Visual ‘bubble’ search**



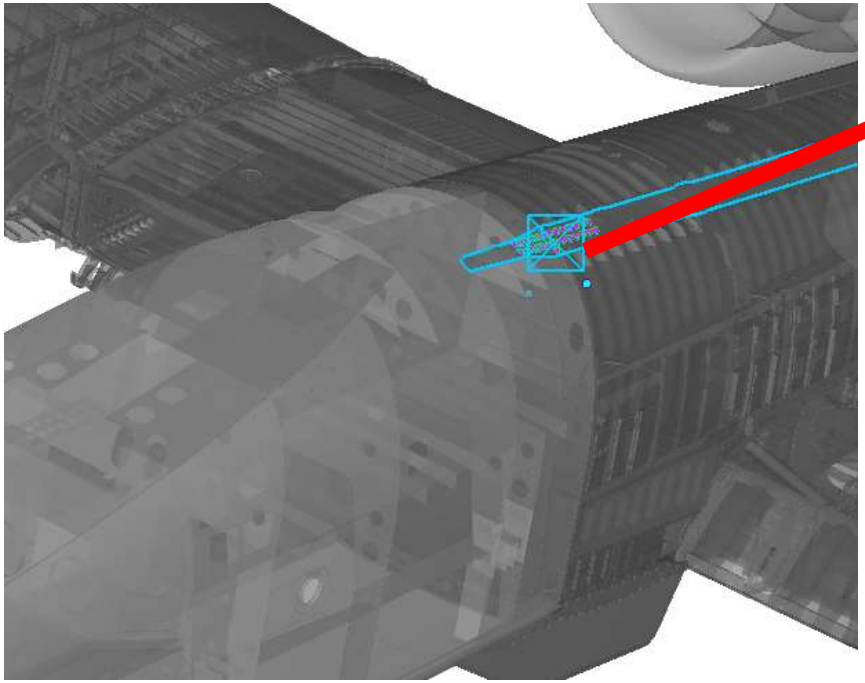
=

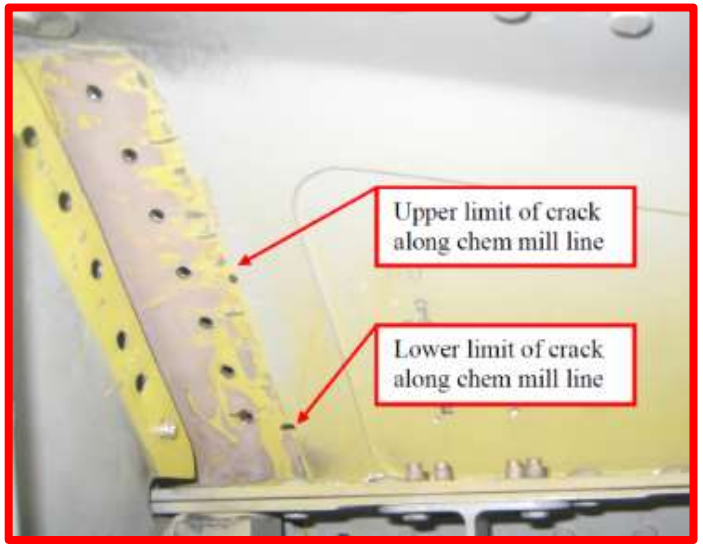


Distribution Statement A: Distribution approved for public release. Case number 88ABW-2016-0882.

Data Search Capability w/NLign

- **Quick access to supporting documentation**
  - **All metadata viewable**
  - **Supporting documents**
    - **Reports, Photos etc.**





Distribution Statement A: Distribution approved for public release. Case number 88ABW-2016-0882.

Training and Tech Data

- Training next generation of maintenance personnel will be key to sustaining aging fleets
- AFRL Sustainment Office partnered with AFRL/RH
  - Leader in developing technologies for training maintainers
- Interest in USAF in leveraging this technology for use in work instructions (technical data)
  - Sometimes called Model Based Instructions

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Interactive Tech Data

- Issue: Tech data is electronic but lacking
  - Simple pdf files
- Vision: Incorporate interactive simulations into tech data
  - AFLCMC/AFSC interest
- AFRL Sustainment Office also connects with AF customer base
  - Participation based on leveraging current projects
  - Assist and advocate to initiate efforts

Concept rendering of interactive electronic tech order system

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

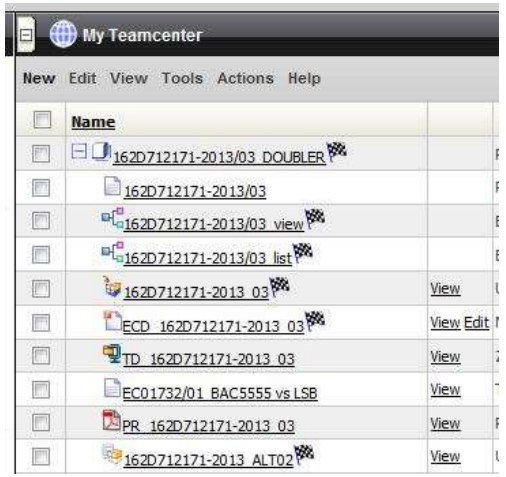
Connection to Engineering

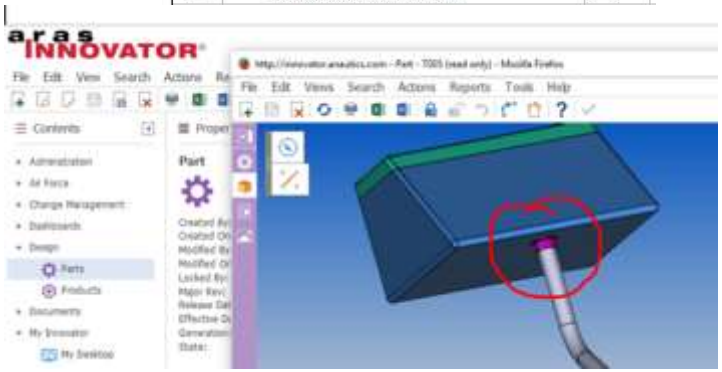
- Mx data must be accessed by engineering personnel
  - Awareness
  - Data used to make decisions regarding assets
- Reporting lags from Mx
  - Some information reported late or not reported at all
  - If maintenance schedules are affected, data is reported quickly
- Engineering/Mx lack effective archival/retrieval systems for data
  - Manual – paper based
  - Multiple systems exist
  - Locations are not centrally accessible

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Connection to Engineering

- USAF has initiatives in establishing a common PLM platform
- AFRL Sustainment Office must be mindful
  - Developing the means to collect data to populate PLM databases
  - Developing applications that will be incorporated onto PLM backbones





Screenshot examples of PLM systems
Data access (top)
Application access (bottom)

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Other Efforts

- Coarse data vs. Fine data types
  - Coarse data (Low-fidelity)
    - Examples: Number of assets, Go-No Go, Supply, etc.
    - Primary users: Logisticians, maintenance
  - Fine data (Hi-fidelity)
    - Examples: Detailed data, images, etc.
    - Primary users: Engineers, maintenance

BOTH DATA TYPES ARE EQUALLY IMPORTANT TO USAF!

- AFRL Sustainment Office has efforts in both areas of data collection and management

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882

Summary

- AFRL Sustainment Office is heavily involved in the Digital Mx Revolution
  - Strong focus on collecting data in Mx environments
  - Developing standard, multi-purpose tools
  - Visualization tools
    - Organize data
    - Review historical records
    - Use in training
  - Others
- Keep our eye on the world around us
  - Integrated with AF initiatives (AFSC “Complex of the Future”)
  - Lead

Distribution Statement A: Distribution approved for public release. Case number: 88ABW-2016-0882