JTEG
Joint Technology
Exchange Group
Joint Solutions for Depot Maintenance

Welcome to the JTEG Monthly Teleconference

Topic:

The Digital Thread and Model Based Enterprise (MBE)

30 June 2015

AGENDA

1300-1309: Welcome and JTEG Background - Greg Kilchenstein (OSD-MPP)

1309-1310: Administrative Notes – Debbie Lilu (NCMS)

1310-1330: Digital Thread Overview – Liz McMichael (NAVAIR)

1330-1350: Digital Twin – Dr. Pam Kobryn

1350-1410: MIL-STD-31000A Update – Roy Whittenburg (UTRS)

1410-1430: PLM & Sharing Digital Data – Rick Mendoza (COMFRC)

1430-1450: 3D PDF as TDP – John Schmelzle (NAWC-Lakehurst)

1450-1510: Cybersecurity and Information Assurance – Dan Green (SPAWAR)

1510-1530: Wrap Up and JTEG Principals' Comments

*** Each presentation will be followed by Q&A**

Joint Technologies Exchange Group (JTEG)

- Provide a forum for the exchange of information on new technology, processes, and equipment developments
- Collect, analyze, and disseminate depot maintenance requirements for new technology, processes and equipment
- Advocate for new technology or equipment with cross-service potential to increase efficiency
- Facilitate joint service technology development

Technology Forum Protocol

- Please keep your phones on mute unless you are presenting. Do *NOT* put your phone on hold. Should you have to temporarily drop off please hang up and call back.
- Questions will be addressed via “Public Chat” on DCS after each presenter.
- Presenters - slides will be advanced by the Administrator
- This is an open forum. Briefs and Q&A are available for public release and will be posted on the JTEG website.

http://jteg.ncms.org

Elizabeth McMichael

Director of Innovation
NAVAIR Aviation Readiness, Naval Air Systems Command

NAVAIR – Digital Thread Overview

Presented to:

Joint Technology Exchange Group

Presented by:

Ms.Elizabeth McMichael

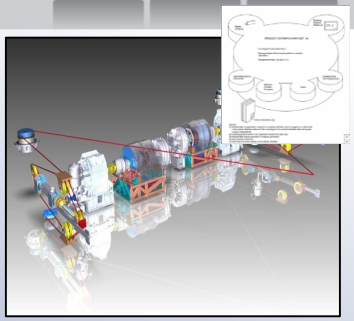
NAVAIR

Operational View

Bridge to Sustainment IT

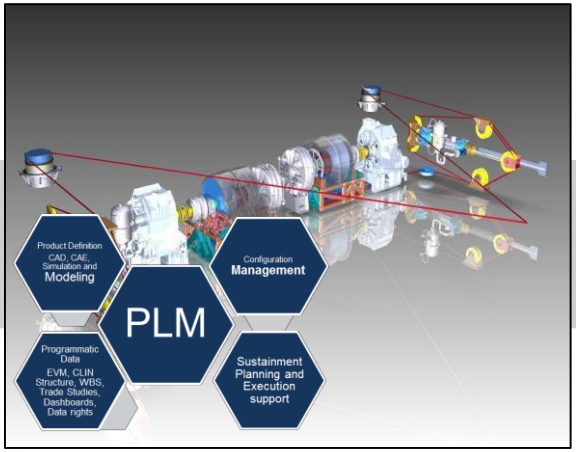
OEM TDP

- Managed in PLM Systems



Data Exchange Services

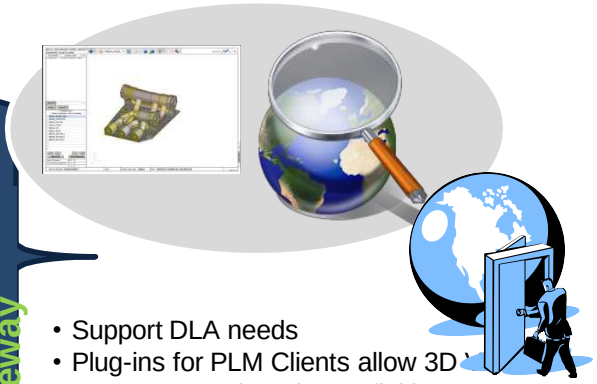
Continuous Technical Assessment
Replication of TDP



NAVAIR PLM

- Single Source of Technical Data, Principal CM tool
- Supports Mgmt. of multiple Native CAD formats
- Leverage existing investment in smart 3D data
- Supports early collaboration on design: OEM&GOV

Enterprise Search & Tech Data Gateway



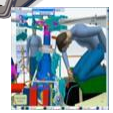
- Support DLA needs
- Plug-ins for PLM Clients allow 3D
- Access to Engineering Definition & Standards

Digital Thread

NAVAIR Sustainment

IETMS/PUBS

OOMA



Training, Maintenance Analysis

FRC

Other Systems...

Enabling the "Digital Thread" for AM

- AM begins with a 3D model from a CAD program
  - Model Design, Organizational Schema and Neutral File Format standards
- ~20% of the output of 3D printers is the final product rather than prototype parts (Penn State)
- Change NAVAIR paradigm
  - Use AM across the Enterprise
  - Better parts (fewer and improved design)
  - Enable rapid qualification
  - Support AM tooling and fixtures
  - Manage all the data
- Additive Manufacturing requires 3D MBE to be successful

Industry Collaboration and Partnership needed

NAVAIR Transformative Goals

- Manufacture and qualify a Flight Critical Component at an FRC with minimal "touch labor"
- Make AM the preferred process for making tools at the FRCs
- Buy AM parts and tooling from DLA and NAVICP
- Manufacture and qualify a flight worthy AM "meta-material" integrating structural and sensor components
- Produce and qualify a rotating component with PHM-capable embedded sensors
- Build an AM printed explosive train with initiating, booster/timing, and main charge elements
- Development cost estimating methodology and should-cost for AM.
- Establish a NAVAIR AM capability for training, prototyping, process development, and standardization of AM.

Execute change necessary to rapidly leverage additive manufacturing for delivery of warfighter capability.

Manufacture and qualify a flight critical, non-proprietary component at an FRC with minimal "touch" labor using additive manufacturing.

Manufacture explosive train using additive manufacturing.

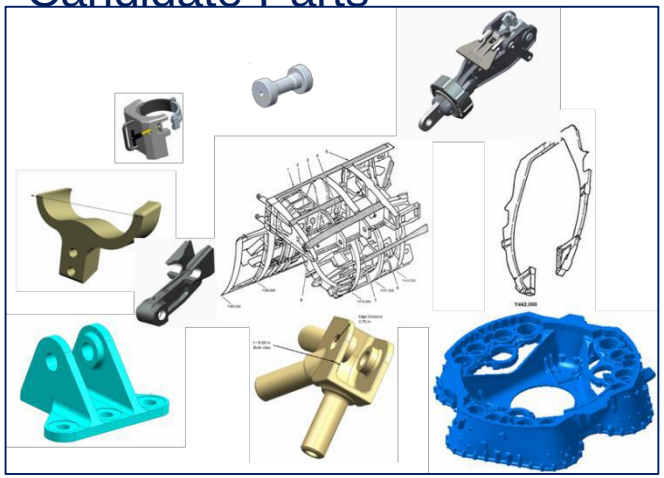
NAVAIR Additive Manufacturing Initiatives

#1 - Field AM Parts

Initiative #1 Projects

- Casting Replacements
- Structural Repair/Replacement
- ALRE/SE Components
- AM Tooling Process Standard
- Weapons and Energetics
- Complex Engine Components
- ▪
- ▪
- Industry/DoD/Other

Candidate Parts



#2 – Demonstrate Rapid Qualification/Certification

Initiative #2 Projects

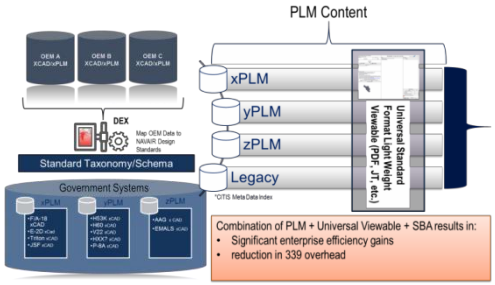
- Material and Process Qualification
- Structural Analysis and Structural Certification
- Non-Destructive Inspection Methods
- Innovative Process Models
- ▪
- ▪
- ▪
- Industry/DoD/Other

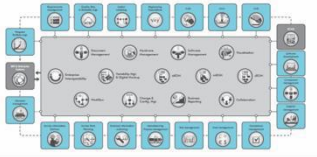
NAVAIR Additive Manufacturing Initiatives

3 – Utilize "Digital Thread" across NAE

Initiative #3 Projects

- 3D/Model Based Environment
- 3D Modeling and AM Digital Environment
- AM Data Architecture/Standards
- AM Build Package Development
- ...
- Industry/DoD/Other

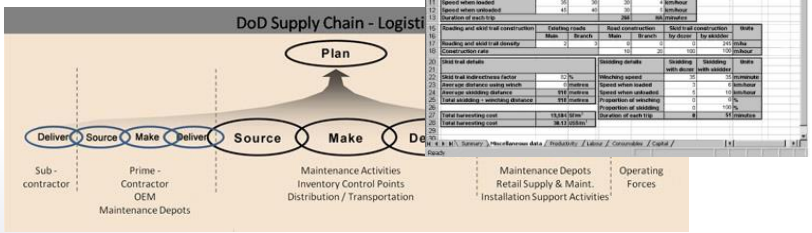




4 – Update Business and Acquisition Processes

Initiative #4 Projects

- NAVSUP and DLA Supply Chain Cost Modeling and ROI
- ...
- Industry/DoD/Other



Questions?

Integrity ★ Service ★ Excellence

Aircraft Digital Twin

Joint Technology Exchange Group technology forum on: Digital Thread & the Model-Based Environment

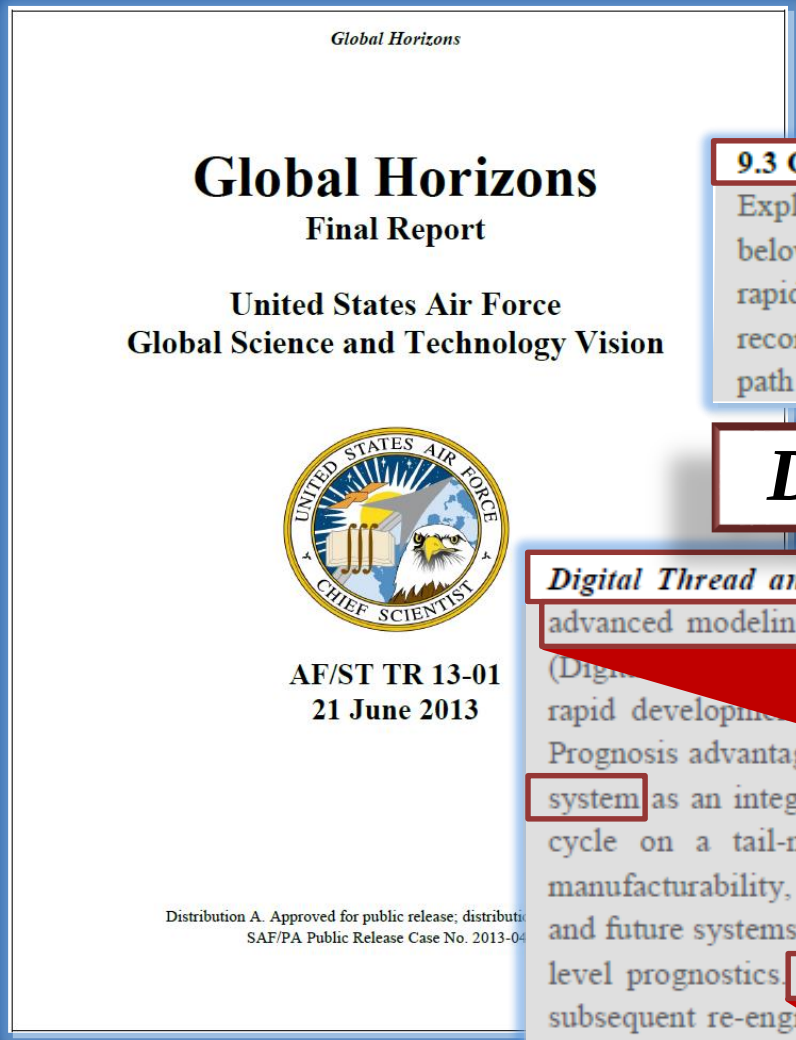
30 June 2015

Pamela A. Kobryn, Ph.D.

Senior Aerospace Engineer

Air Force Research Laboratory

Why Digital Thread / Digital Twin?


Global Horizons

Global Horizons
Final Report

United States Air Force
Global Science and Technology Vision

AF/ST TR 13-01
21 June 2013

Distribution A. Approved for public release; distributi
SAF/PA Public Release Case No. 2013-04

9. Manufacturing and Materials

9.3 Game Changers

9.3 Game Changers

Exploiting the three game-changing opportunities below will help the AF meet the need for more rapid development and deployment. The recommendations represent the first steps on the path to future game-changers.

Digital Thread and Digital Twin

Digital Thread and Digital Twin. The concept of a digital thread/digital twin comprised of advanced modeling and simulation tools design-processing-manufacturing (Digi needed for rapid develop nd System Prognosis advantages will be achieved through the Digi virtual representation of the system as an integrated syst e cycle on a tail-numb ptimize manufacturability, inspe from legacy and future systems will provide the basis for refined models that enable component and system-level prognostics. Archived digital descriptions ems would greatly facilitate any subsequent re-engi itoring will enable adaptation of systems to t

advanced modeling and simulation tools

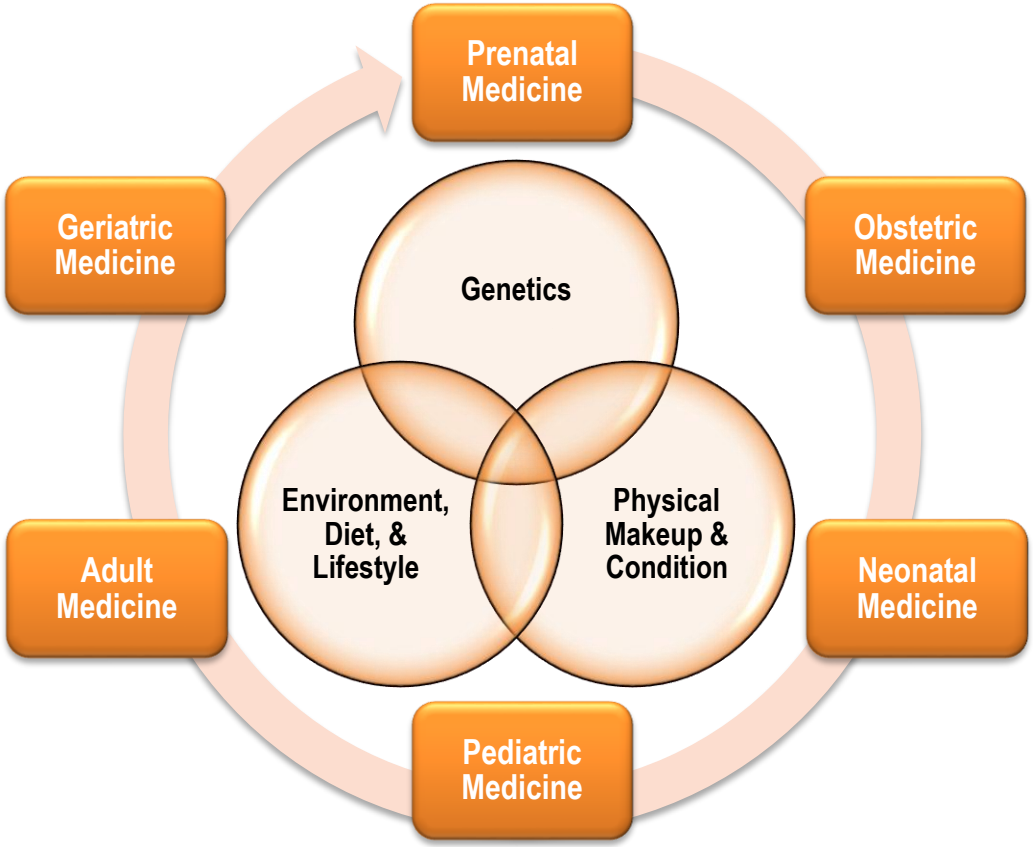
virtual representation of the system

Archived digital descriptions

An Analogy: The Future of Healthcare

"TO BE" State:

- **Treatments are based on early identification of disease & disease precursors**
- **Electronic Medical Records & Personal Health Records available to patients & providers**
- **Preventative medicine & disease treatments are personalized to each patient**
- **Majority of effort is in predicting, preventing, & managing disease throughout life**

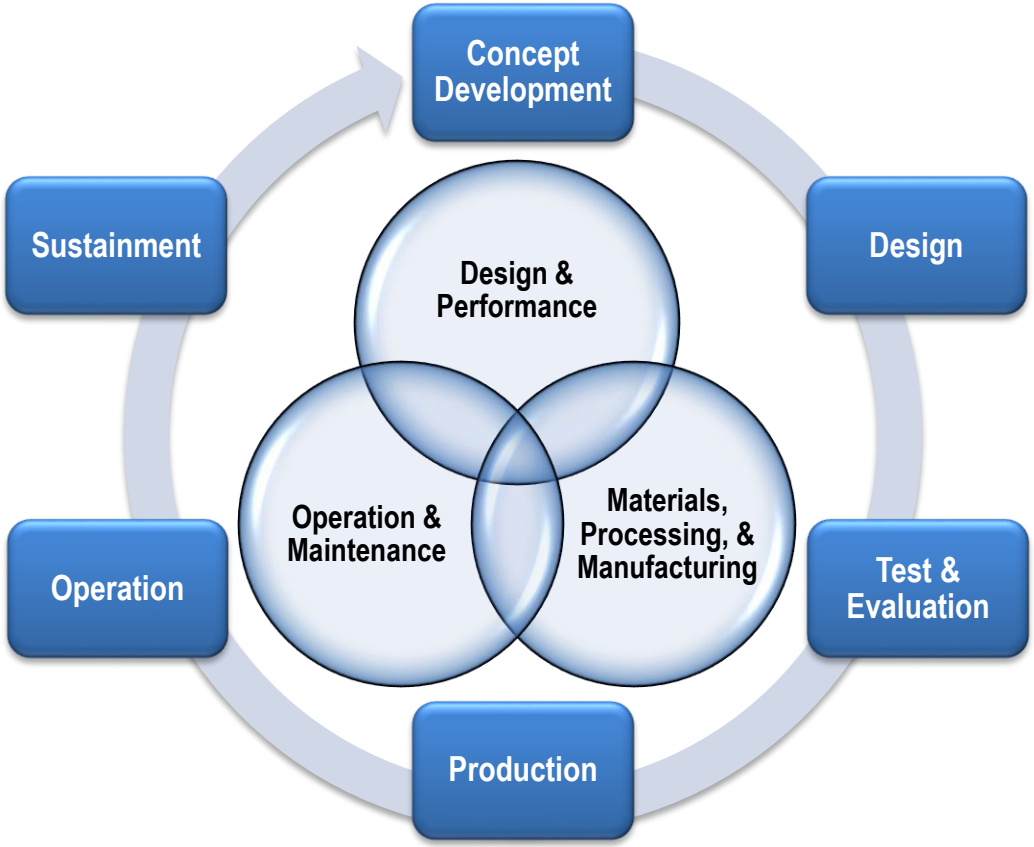


Future Healthcare will be Predictive, Integrated, Personalized, and Preventative

The Future of Aircraft Lifecycle Management

"TO BE" State:

- Maintenance based on early identification of damage & damage precursors
- Individual aircraft history available to operators, maintainers, & engineers
- Preventative maintenance & repairs / retrofits are personalized to each aircraft
- Majority of effort is in predicting, preventing, & managing damage state throughout life



Future Lifecycle Management will be Predictive, Integrated, Individualized, and Preventative

What is a Digital Twin?

"An integrated multiphysics, multiscale, probabilistic

***simulation of an as-built system*,**

***enabled by Digital Thread*,**

that uses the best available models, sensor information, and input data to mirror and predict activities/ performance over the life of its corresponding physical twin."

(source: DAU Glossary of Defense Acquisition Acronyms and Terms)

A Digital Twin is **NOT:**

- a Digital Tool for Configuration Management
- a 3D Geometric Model of an As-Built System
- a Model-based Definition of an As-Built System

What is a Digital Thread?

"An extensible, configurable and component enterprise-level

analytical framework

that seamlessly expedites the controlled interplay of

authoritative technical data, software, information, and knowledge

in the enterprise data-information-knowledge systems, based on the Digital System Model template, to inform decision makers throughout a system's life cycle by providing the capability to access, integrate and transform disparate data into actionable information."

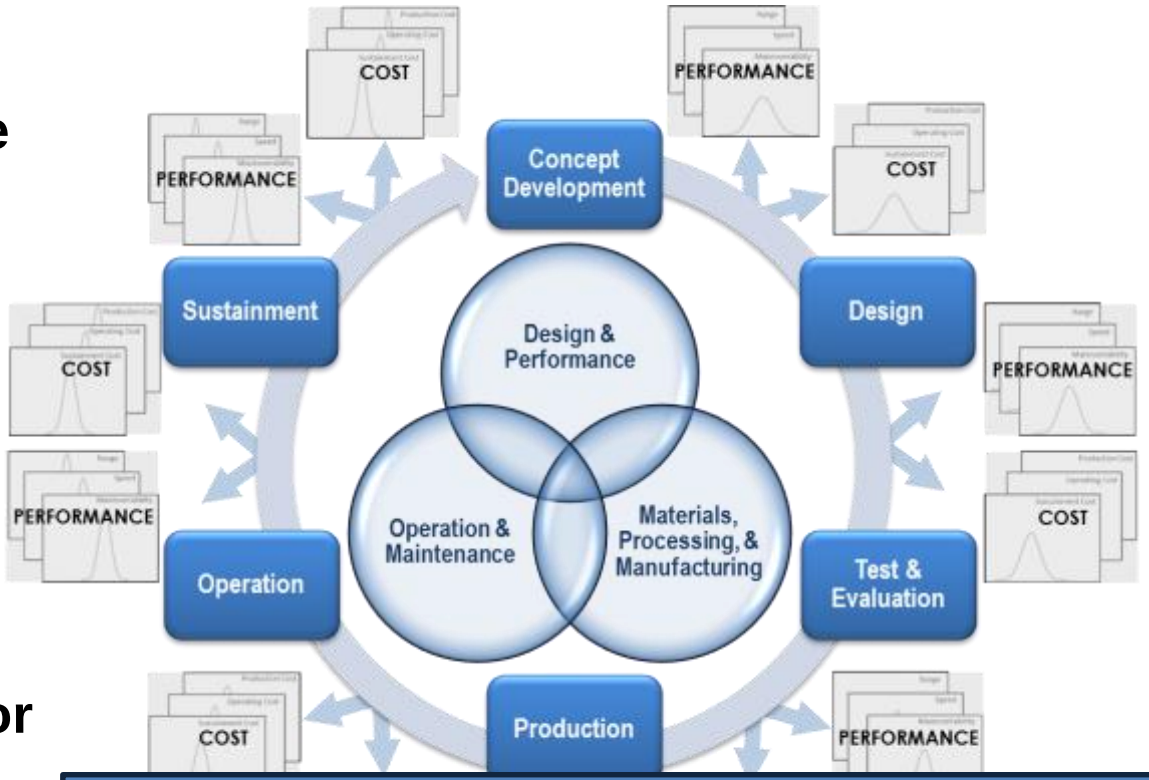
(source: DAU Glossary of Defense Acquisition Acronyms and Terms)

Digital Thread is **NOT** limited to manufacturing.

The Digital Thread "Pinwheel"

Key Attributes:

- **Complete, fully accessible digital data**
- **Tools for accessing, integrating & transforming data**
- **Virtual representations of systems in a modeling & simulation environment**
- **Probabilistic framework for quantifying, forecasting, and updating system performance capability**

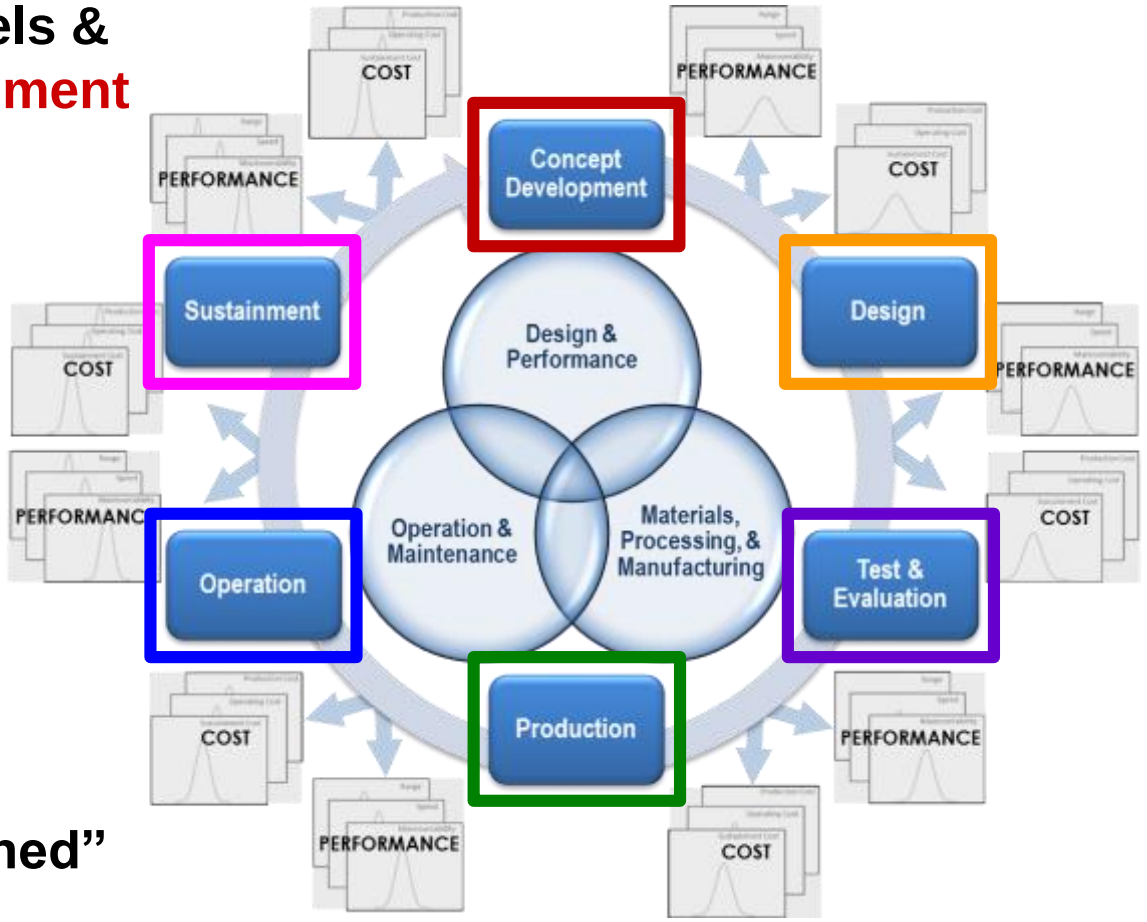


Make ***INFORMED DECISIONS*** throughout acquisition

Create a ***DIGITAL SURROGATE*** of the materiel system

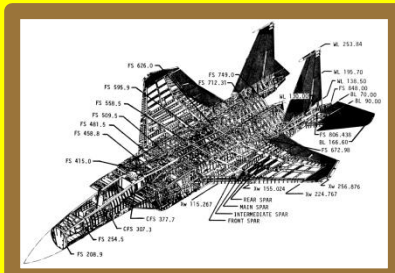
Digital Thread Analysis Progression

- Develop preliminary models & req’ts in Concept Development
- Develop detailed “as designed” models & req’ts in Design
- Validate/calibrate in Test & Evaluation
- Update using “as built” data from Production
- Update using “as flown” data from Operation
- Update using “as maintained” data from Sustainment

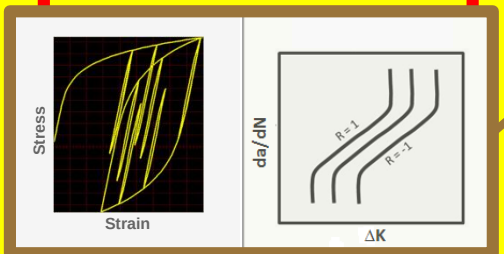


Requires formalized framework(s) for linking & updating across both acquisition phases *and* technical domains.

Airframe Digital Twin



Tail Number Specific Geometry

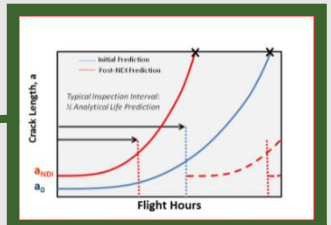


Material Properties

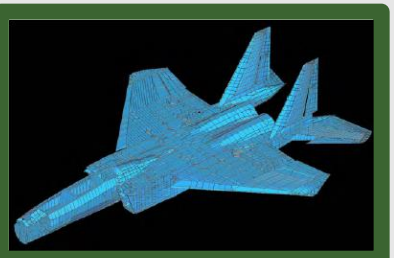
Flight Test Data

Airframe Digital Twin

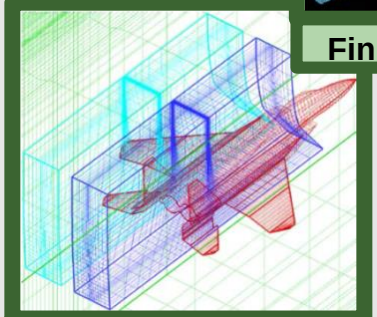
Inspection & Maintenance Data



Damage Growth Models



Finite Element Model



Aerodynamic Model

Digital Twin requires **DATA** and **MODELS** from Digital Thread

Summary

- **Digital Thread and Digital Twin are synergistic concepts**
  - **Digital Twin is a digital surrogate model of the system used to simulate system performance and/or reliability**
    - Preliminary utility will be for maintenance planning
      - Tailoring maintenance by tail number
  - **Digital Twin requires data and models from Digital Thread**
    - Digital Thread will involve multiple users of common data and models for different purposes
      - Requires special attention to how data and models are organized, formatted, stored, accessed, protected, etc.

Questions?

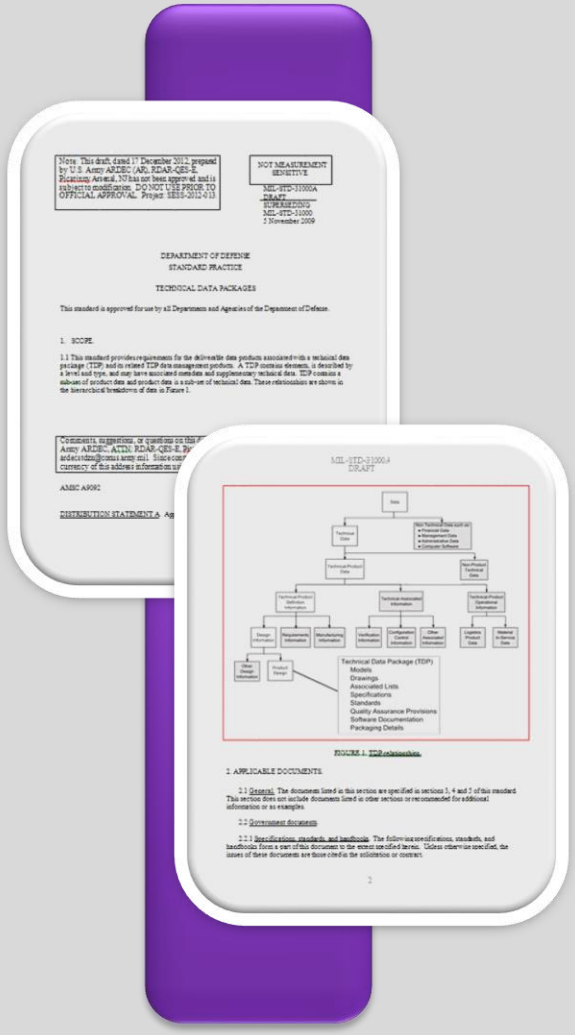
MIL-STD-31000A

Update

Prepared By:
Roy Whittenburg

MIL-STD-31000A

- **The Military Standard defining Technical Data Packages**
- **Previously known as MIL-DTL-31000C**
- **Defines both Drawing Based and 3D TDPs**
- **Used to provide requirements for placing TDPs under contract**



Transforming the DoD

From This

To This

TDP – The Heart Of The Standard

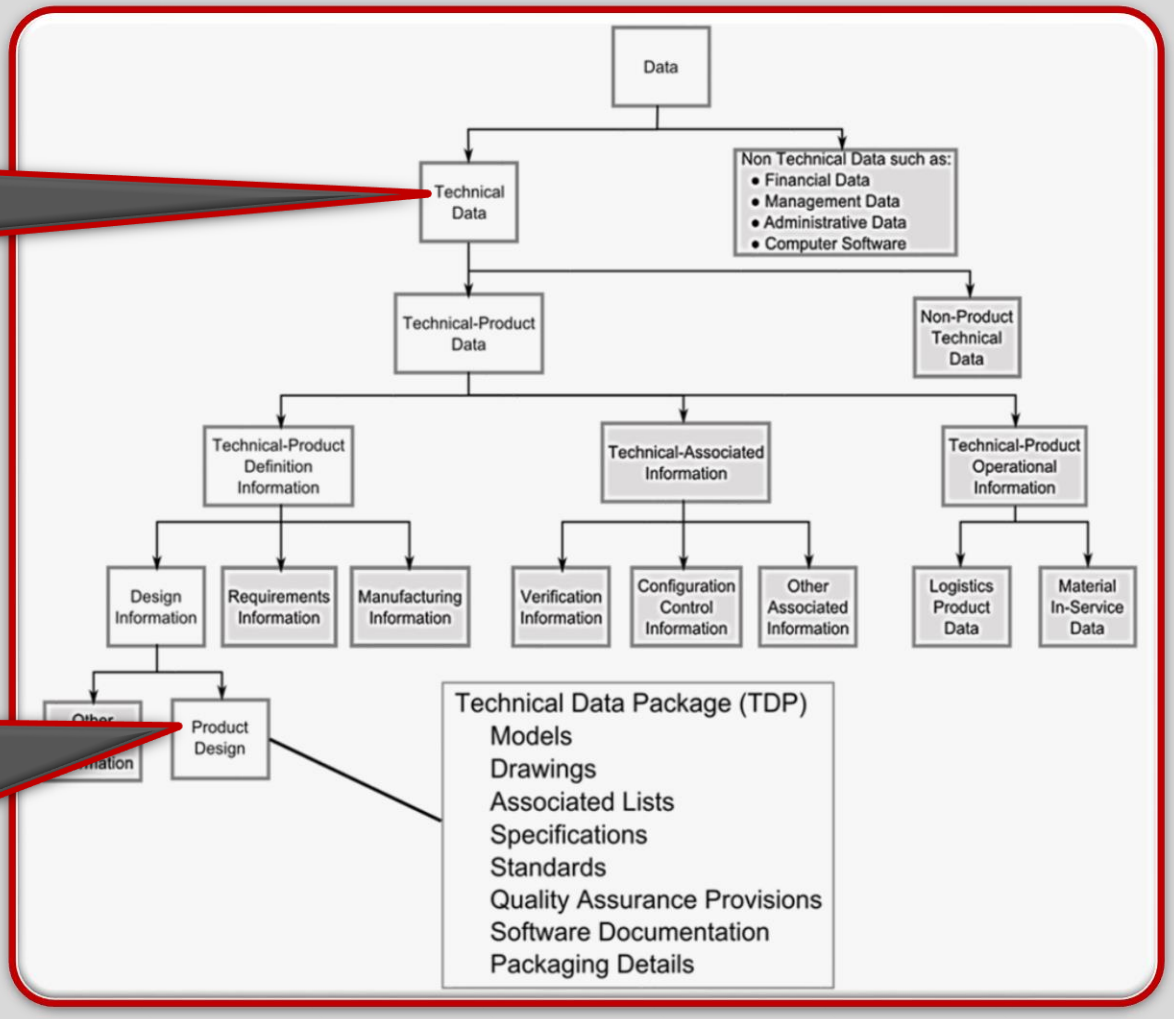
MIL-STD-31000A defines a TDP as:

"A technical description of an item adequate for supporting an acquisition, production, engineering, and logistics support (e.g. Engineering Data for Provisioning, Training, and Technical Manuals). The description defines the required design configuration or performance requirements, and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, drawings, associated lists, specifications, standards, performance requirements, QAP, software documentation and packaging details."

TDP In The Hierarchy Of Data

Technical Data Includes Many Types of Data

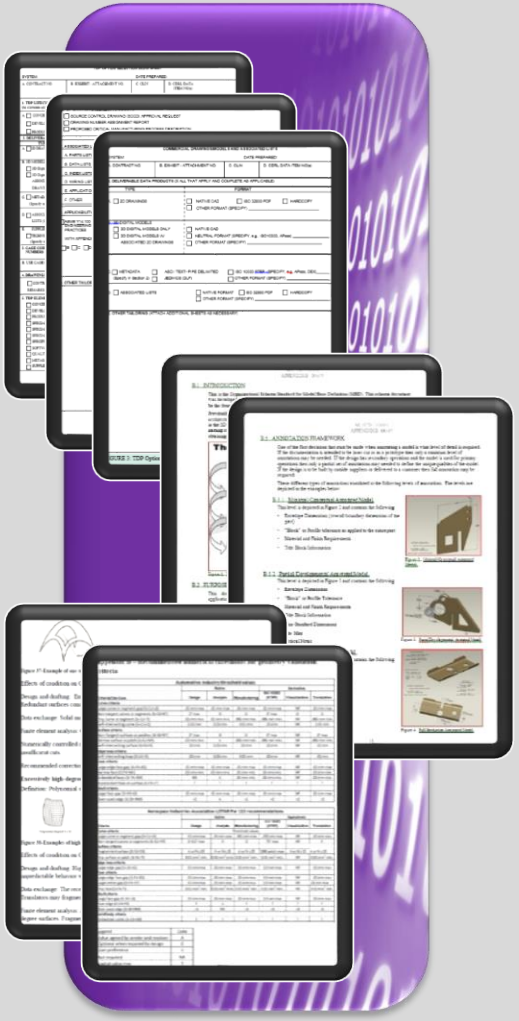
The TDP is a subset of Product Design Data which is on the bottom tier of data



Appendixes

MIL-STD-31000A has three Appendixes:

- Appendix A: Selection and Ordering Guidance
  - How to use the TDP Option Selection Worksheets
- Appendix B: MBD Model Organizational Schema
  - How to organize the information in a solid Model
- Appendix C: 3D TDP Validation Guide
  - How to measure the quality of a 3D Model



Current Related Activities

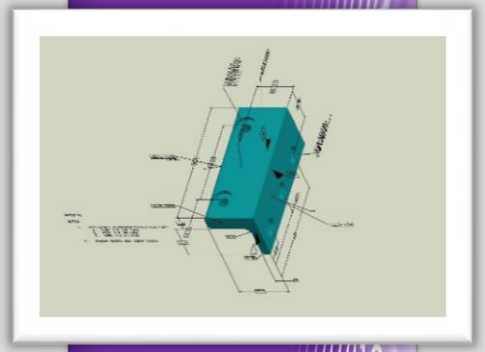
There are two activities currently underway regarding MIL-STD-31000A:

- The transfer and update of Appendix B to ASME
  - ASME has not only agreed to this activity but has established a new standard and associated committee to address it (ASME Y14.41.1)
- The transfer and update of Appendix C to MIL-HBK-288
  - This handbook covers the validation of TDPs and was a logical place for the 3D TDP Validation Guide
  - This work is nearing completion

What is in ASME Y14.41.1

This standard is intended to replace Appendix B

- It will contain the contents of the appendix but in a more generic and “standard” language
- In the initial release it will also introduce a “completeness” measure that will replace and supplement the current levels of annotation
  - It’s intent is to provide a quick reference on both the data set’s maturity and intended use
- Future revisions of this standard will evolve it into a more complete schema that address the broader range of technical data



Current Challenges to Adoption

- The primary challenge to adoption of MBE and 31000A is one of training
  - The contraction officers need to be trained on how to use it
  - The engineers who are responsible for both the tailoring (option selection worksheets) and writing the SOWs for contracts need to understand it
  - The Primes need training on how it effects them
- Another barrier is the lack of follow through on purchasing the TDPs by the PMS and their miss conceptions (that drawings are required and MBD cost to much)

Questions?

Thank You

Image by DoD Live

Thank you

for your time and consideration

2014 CTMA Project Update

PRODUCT LIFE CYCLE MANAGEMENT FOR AIRCRAFT SUSTAINMENT AND SUPPORT PROJECT COMFRC

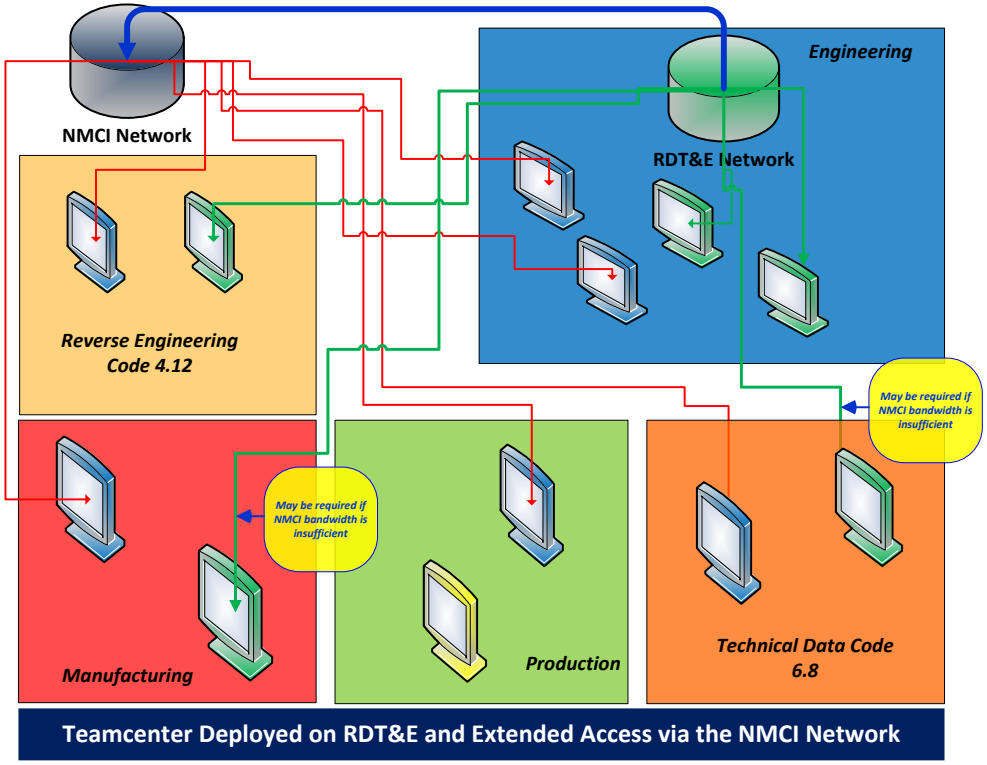
Approved for Public release. Distribution is Unlimited
FRCSW 15-0013

Rick Mendoza- Fleet Readiness Center Southwest
COMFRC Industrial Connectivity and MBE Deployment Implementation Team Lead

2014 CTMA Project Update

Environment after implementation

- 3MS process can be accessed from a single computer, either NMCI S&T seat or RDT&E
- Process occurs within an integrated Teamcenter environment across both networks, live
- Data and Process are configuration managed
- Engineering Data is created and resides on RDT&E but can be accessed from either Network from all 3 depots



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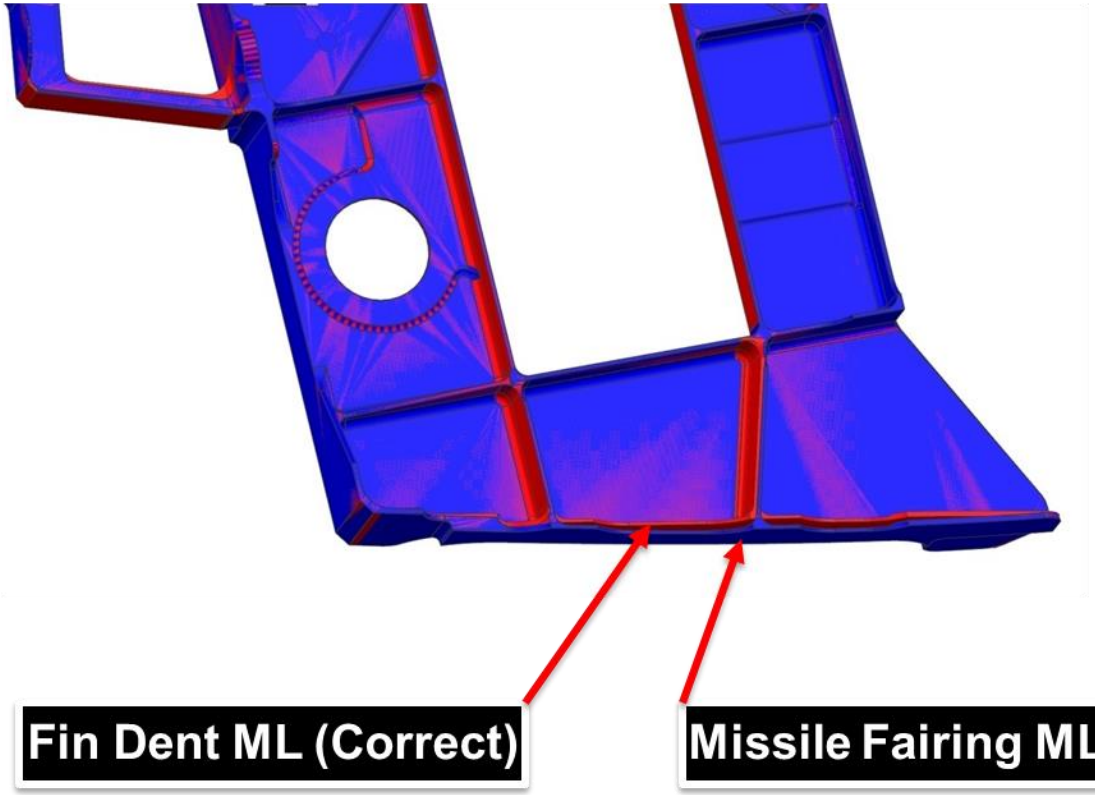
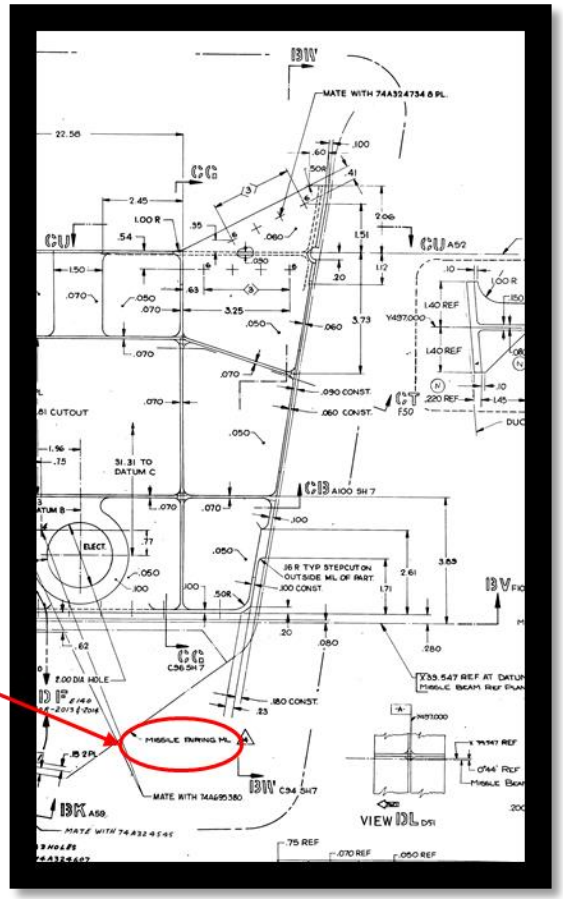
FRC-Technical Data Access

2014 CTMA Project Update

Blueprint Errors – Wrong Information





Example of incorrect call-out on a blueprint

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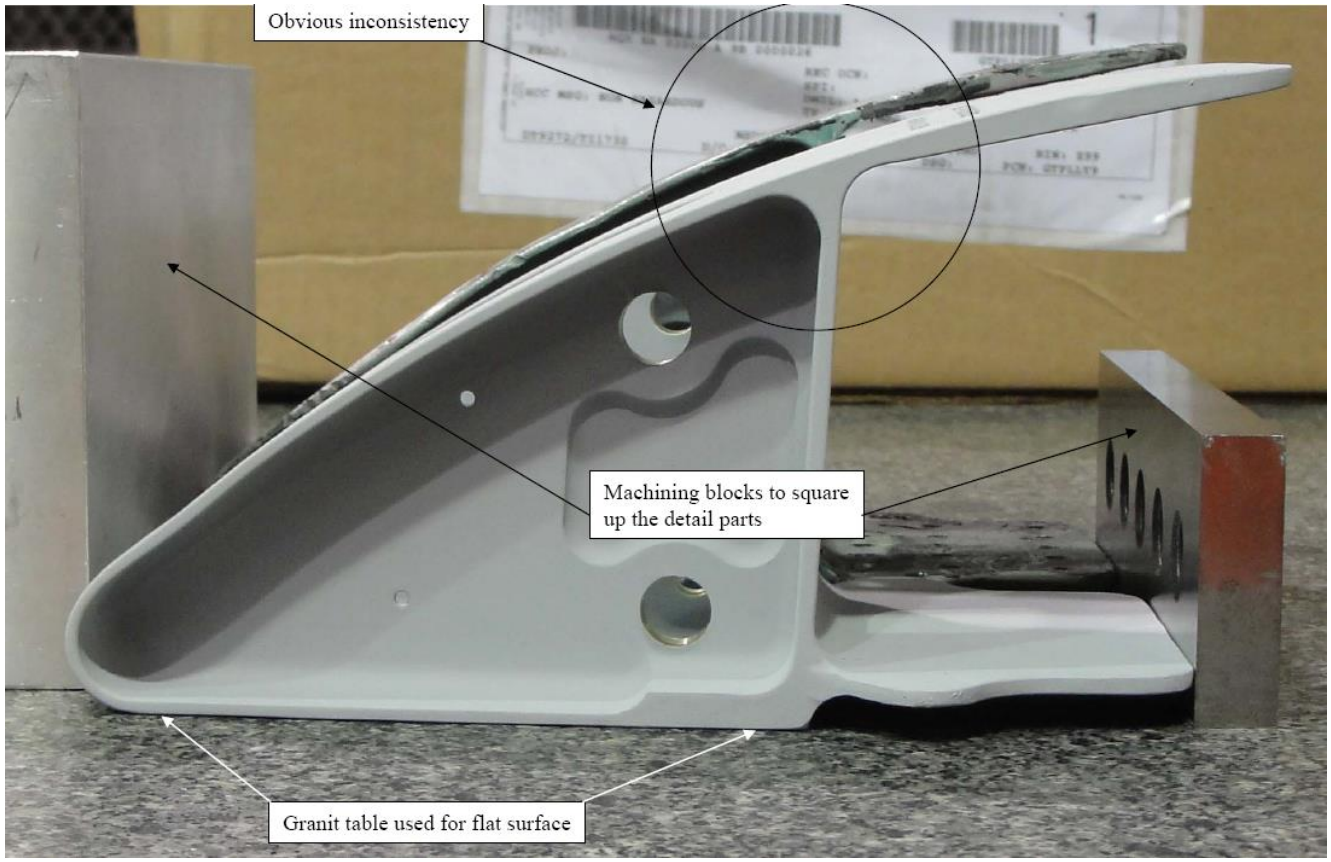

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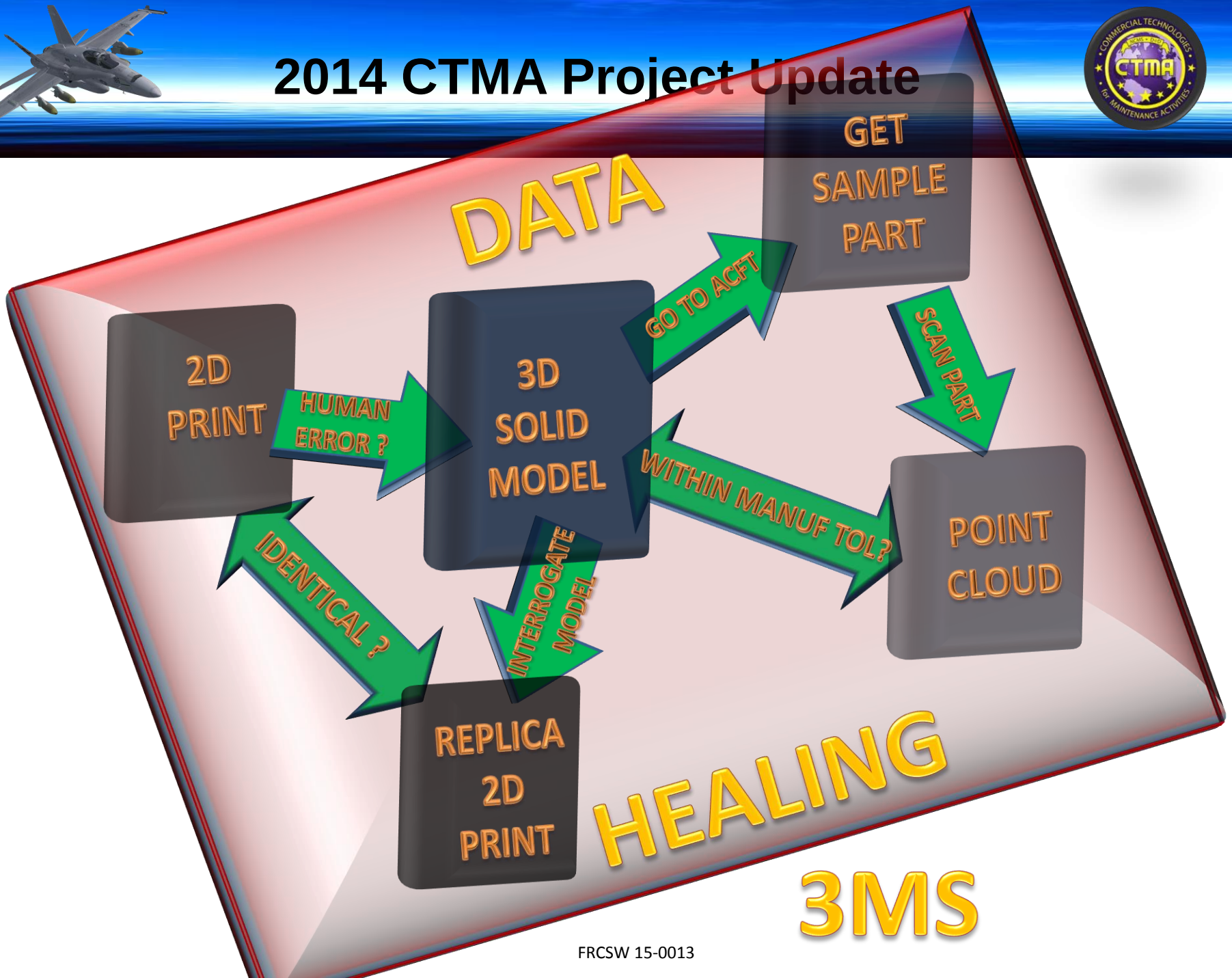

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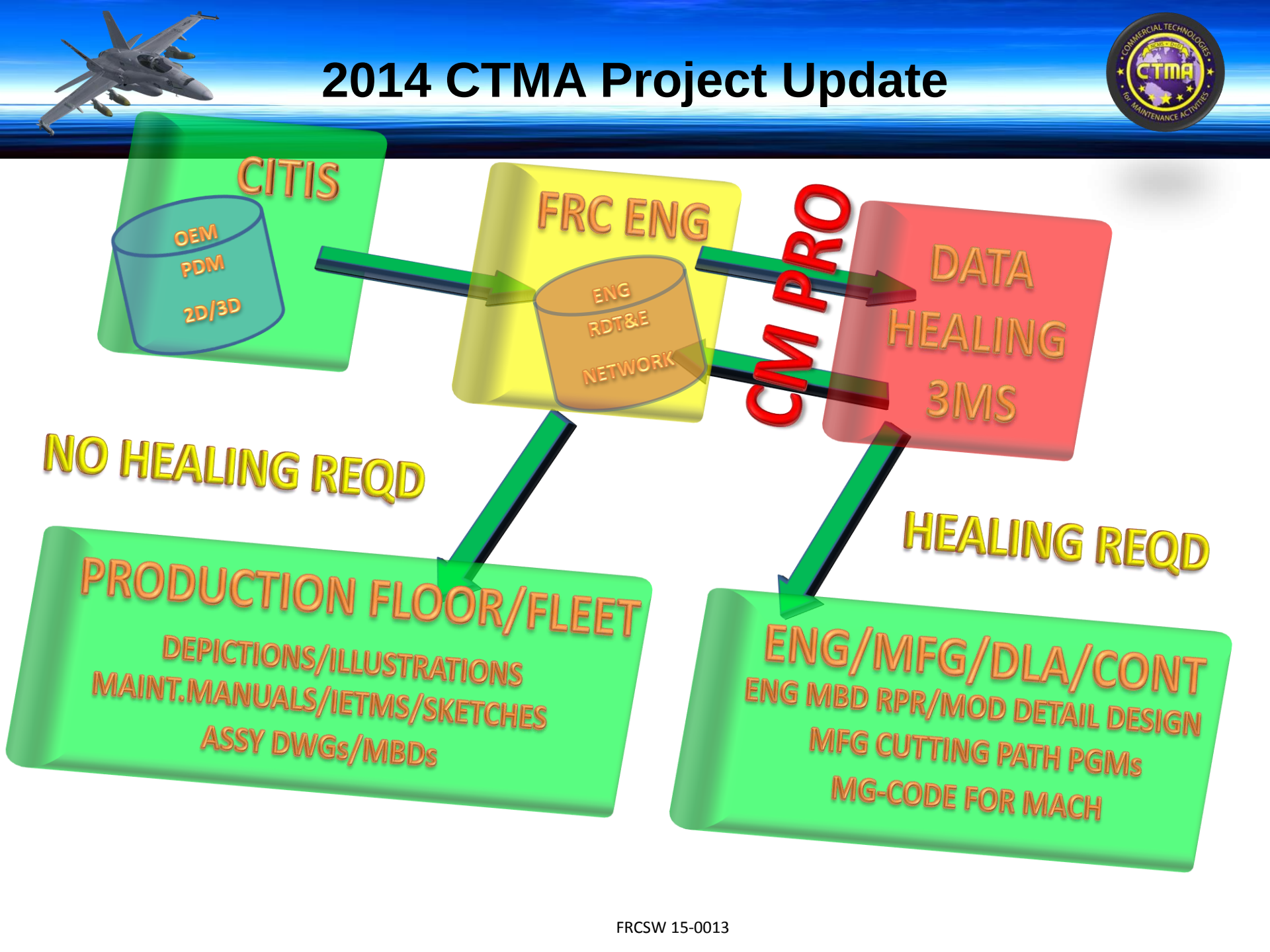
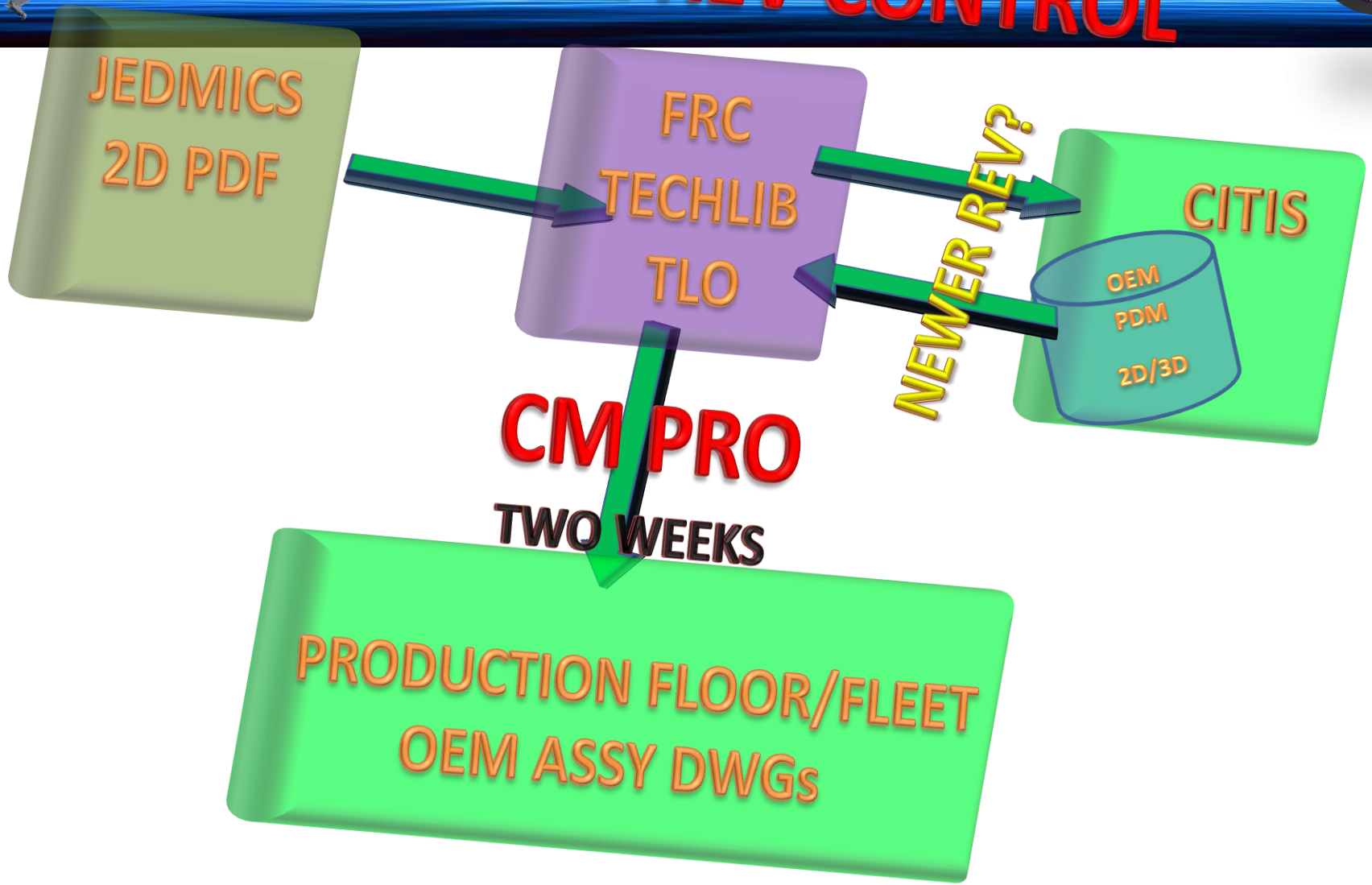


MANUAL REV CONTROL



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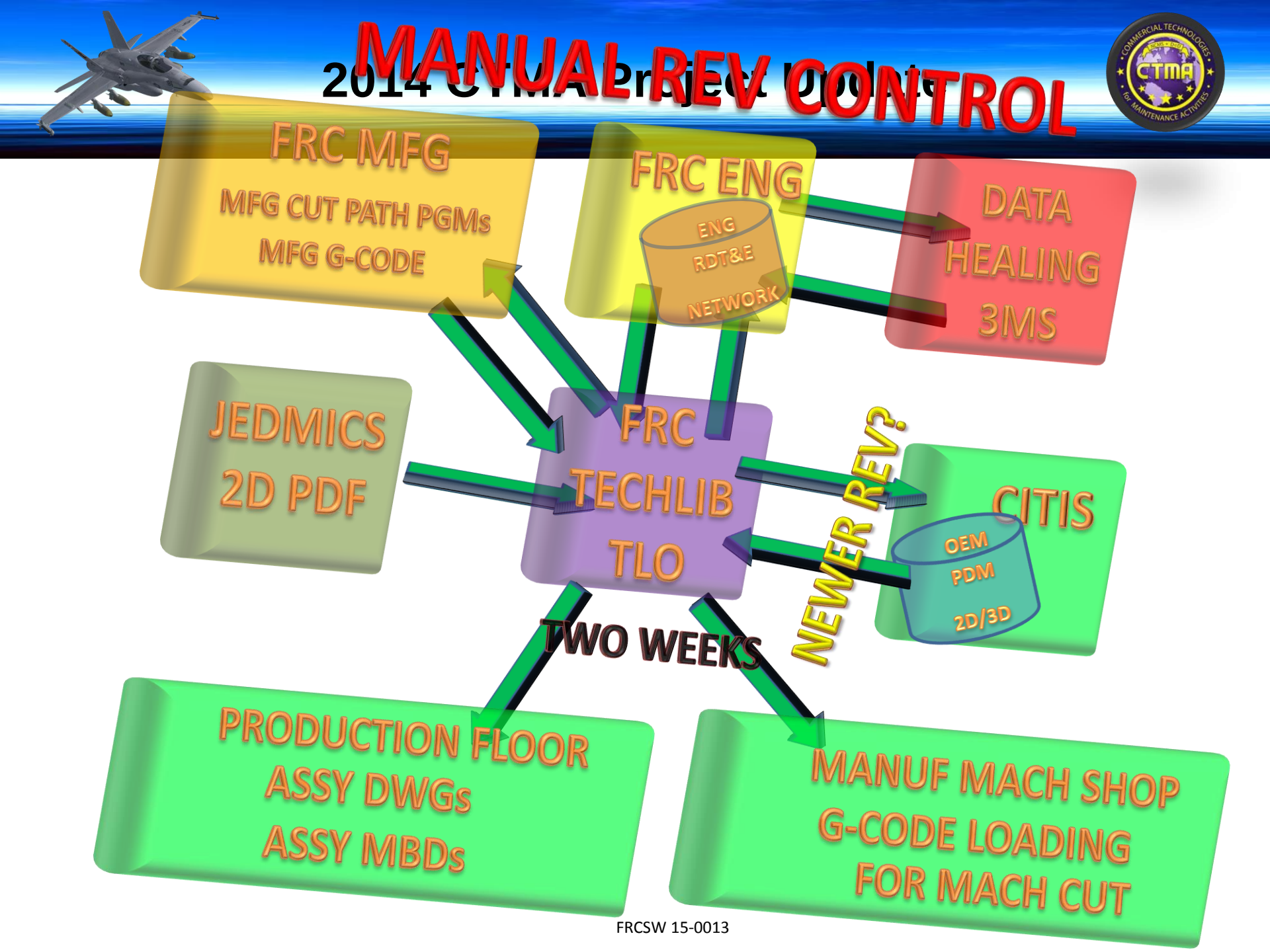
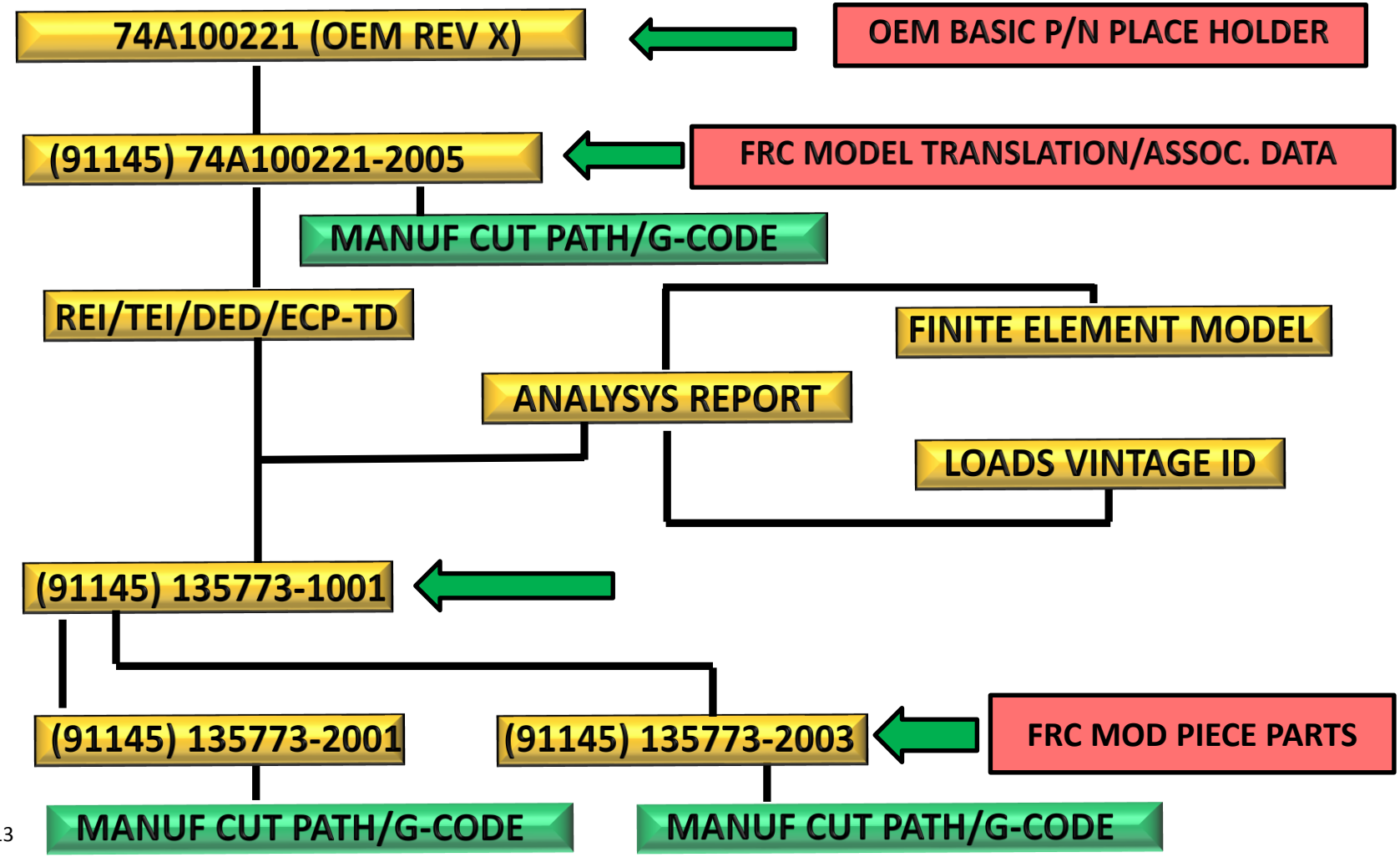


2014 CTMA Project Update

FRC Part Association Scheme, (Phase II Ext)



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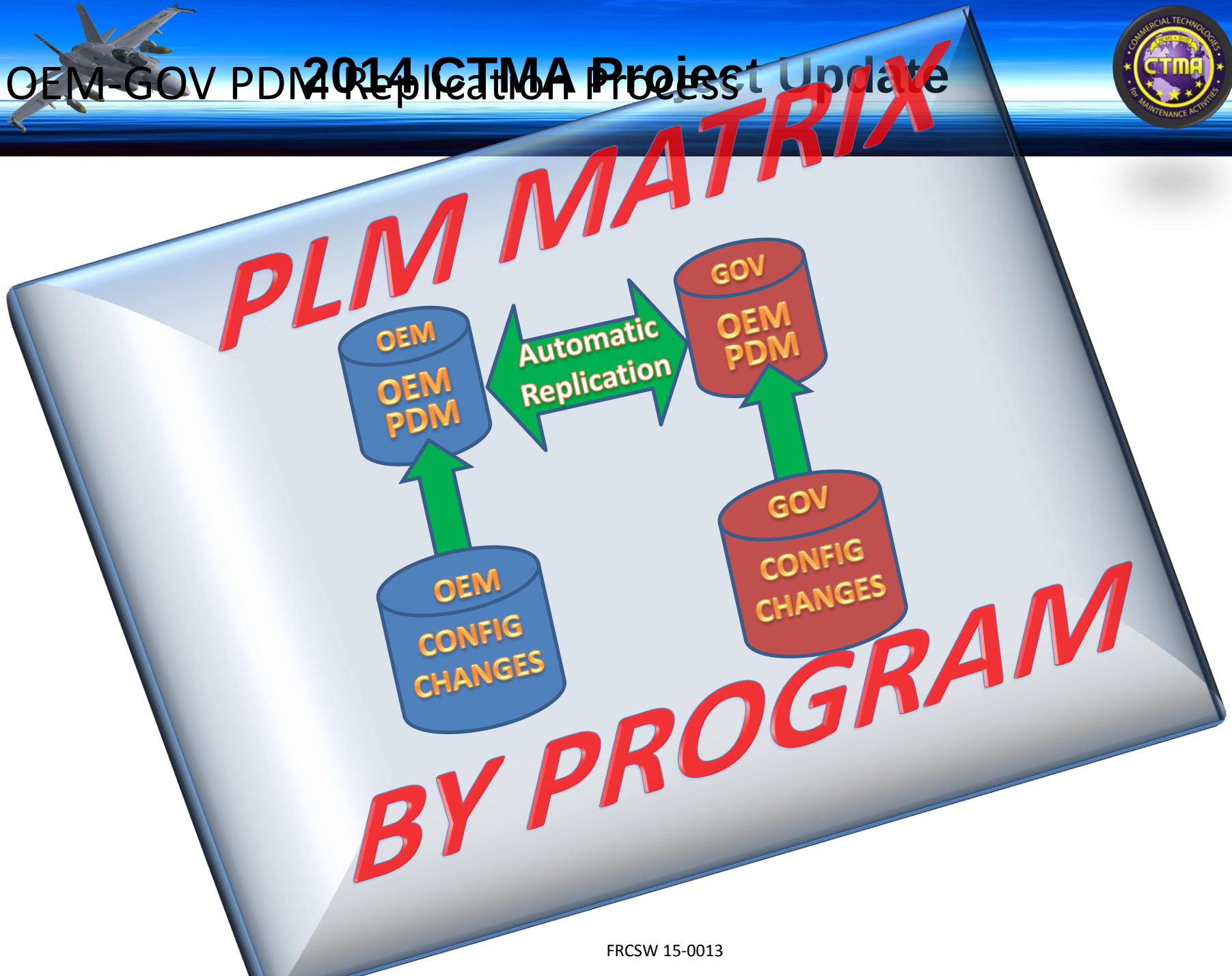
MANUAL REV CONTROL

OEM-GOV PDM Replication Process

2014 CTMA Project Update



OEM INVOLVED IN ECP/MOD/REDESIGN THROUGHOUT LIFECYCLE OF SYSTEM

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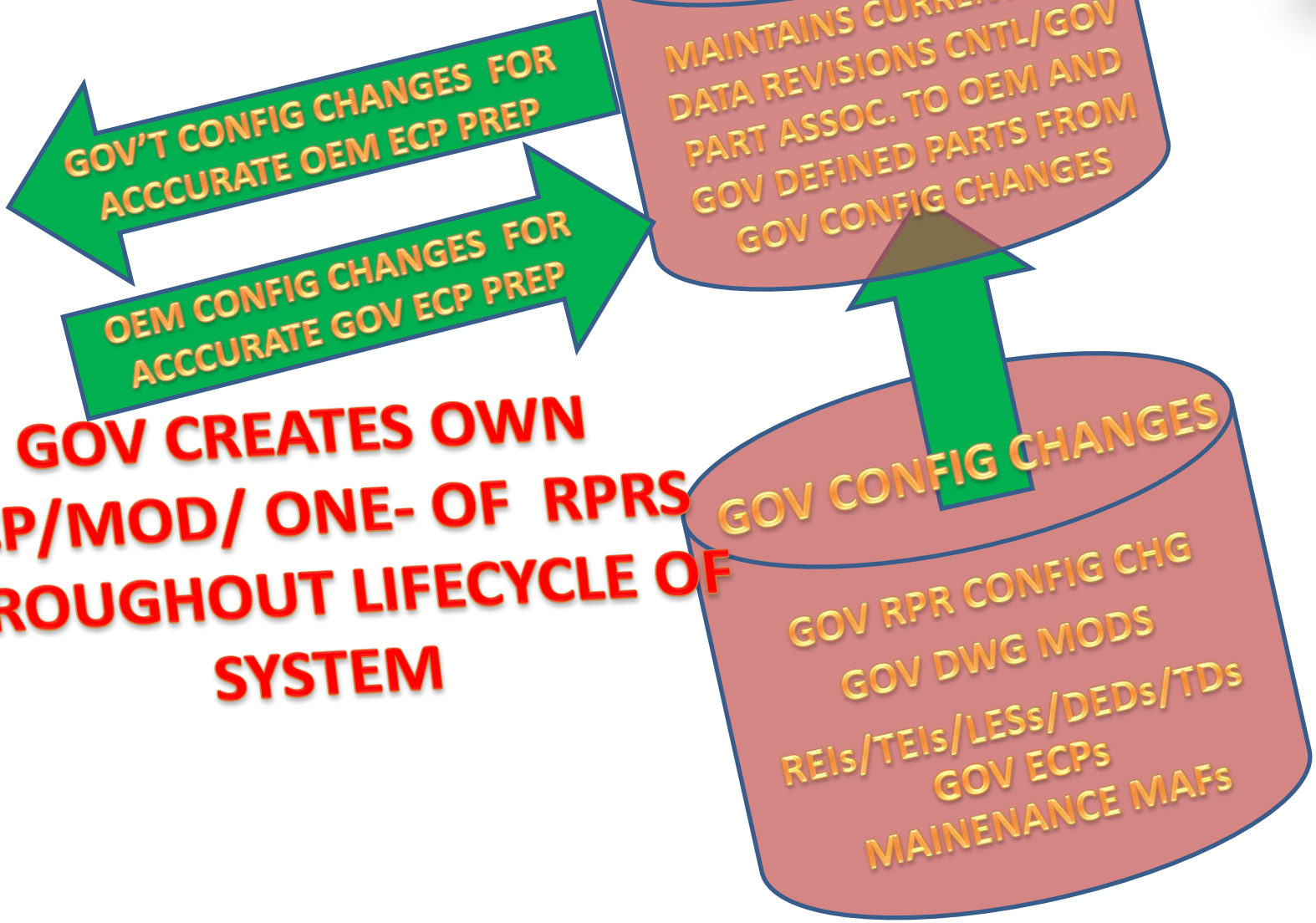

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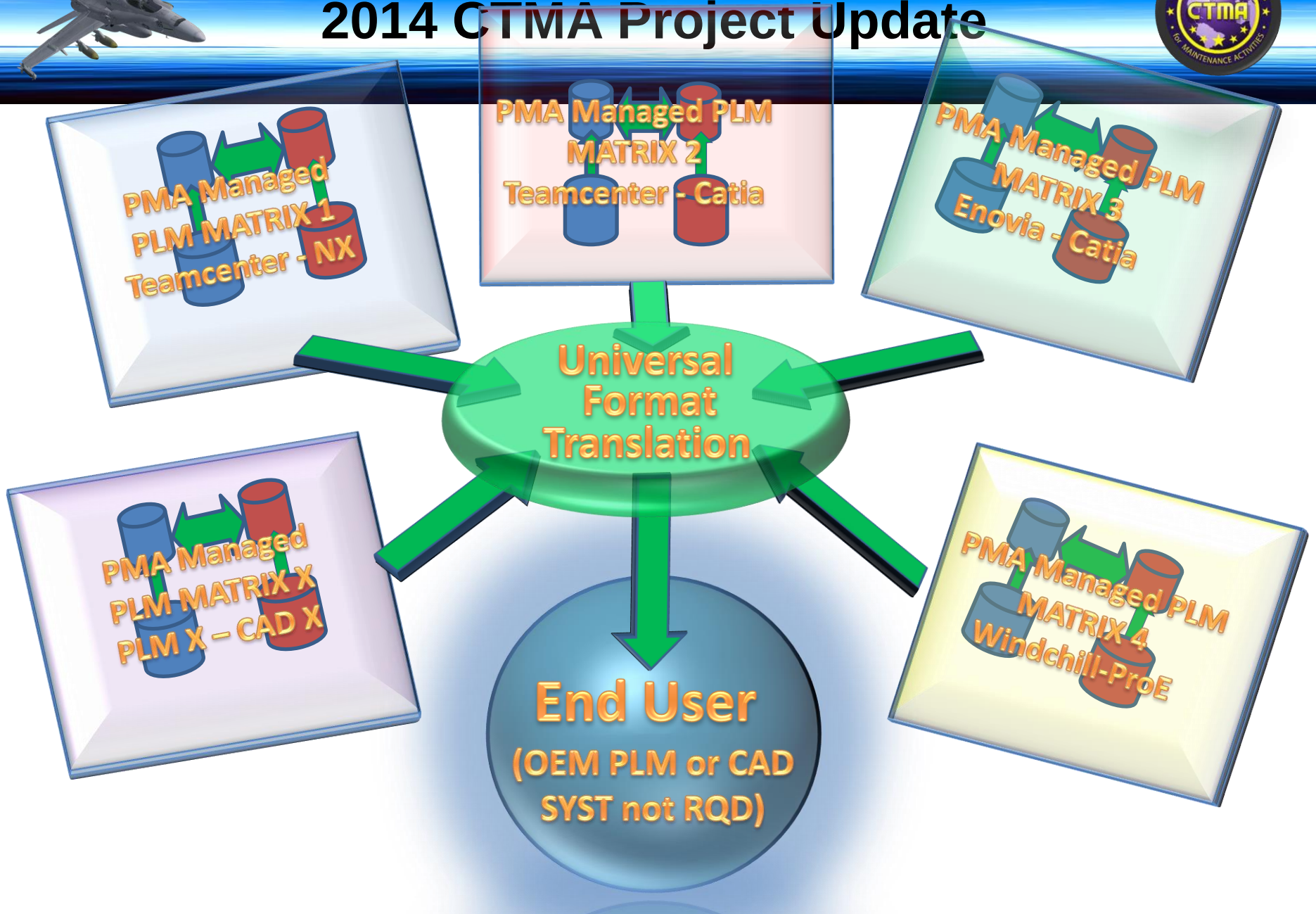
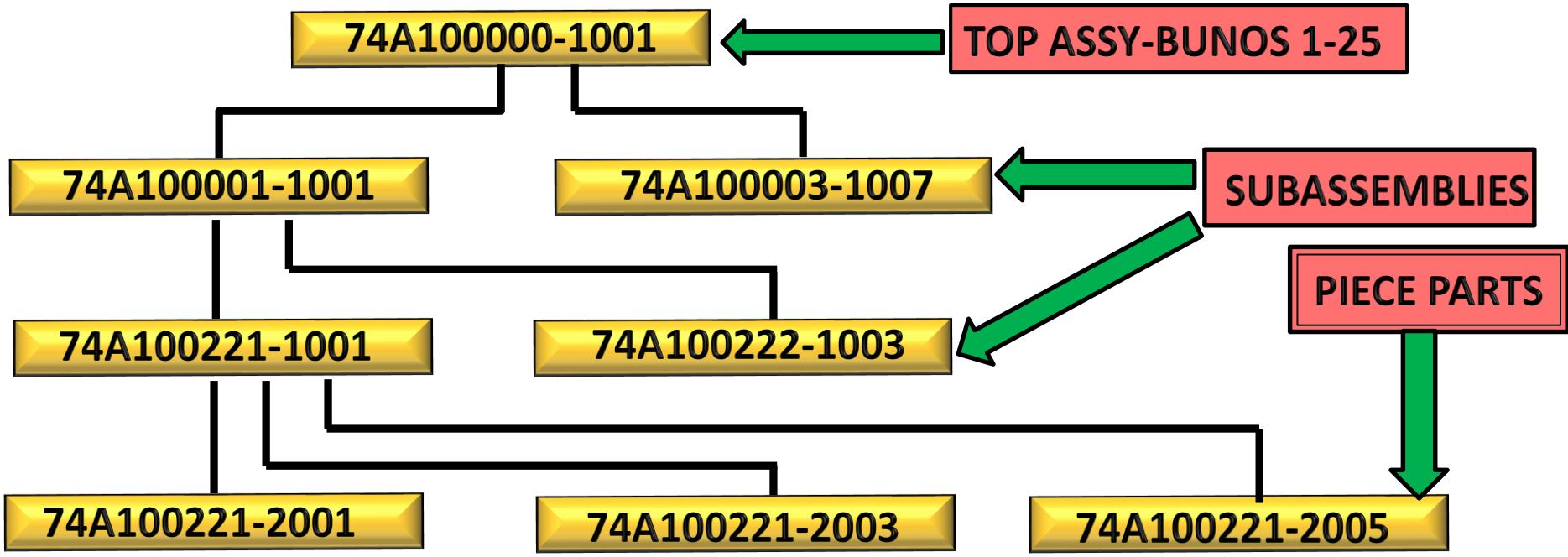
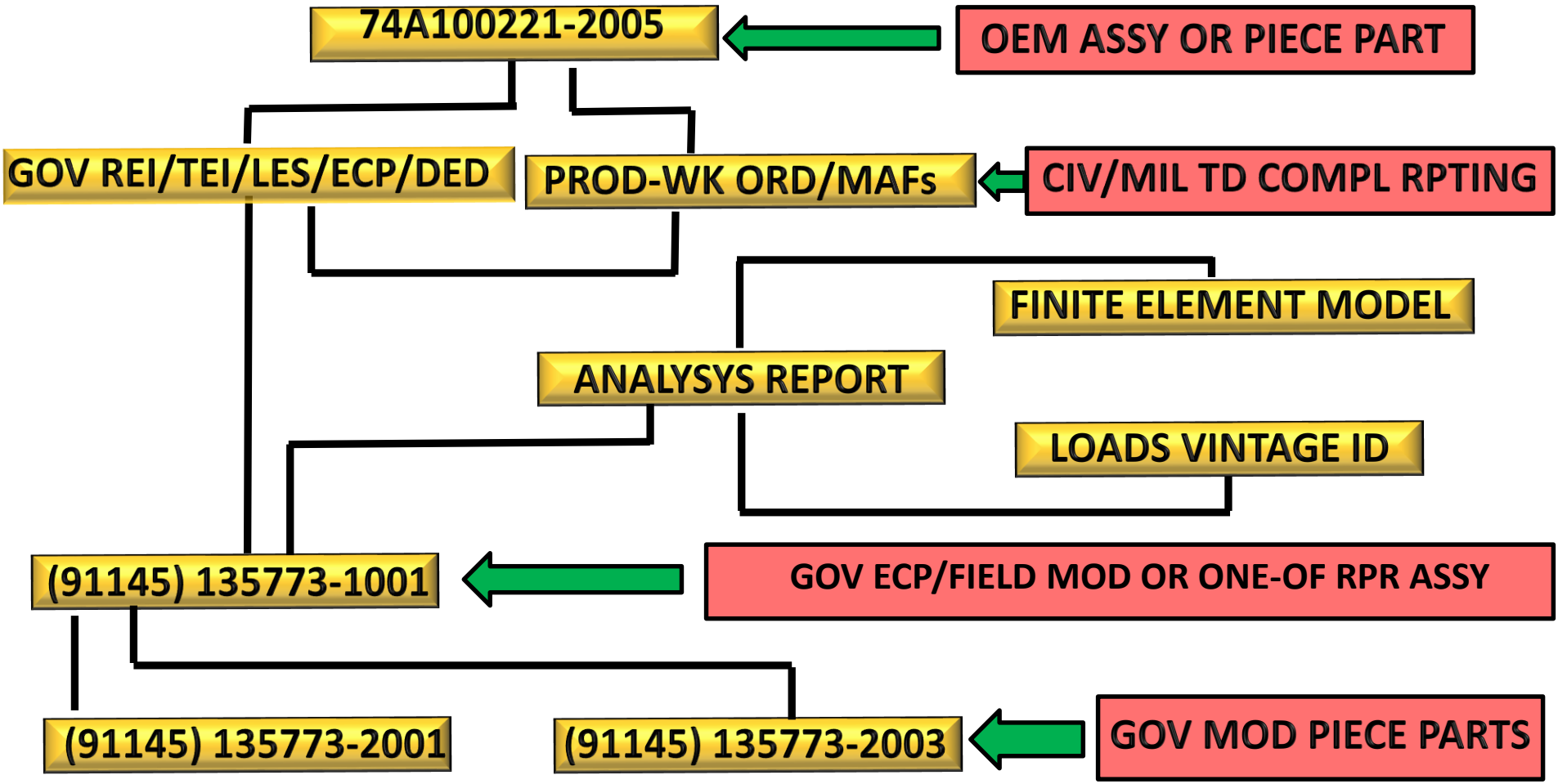


OEM Part Associations



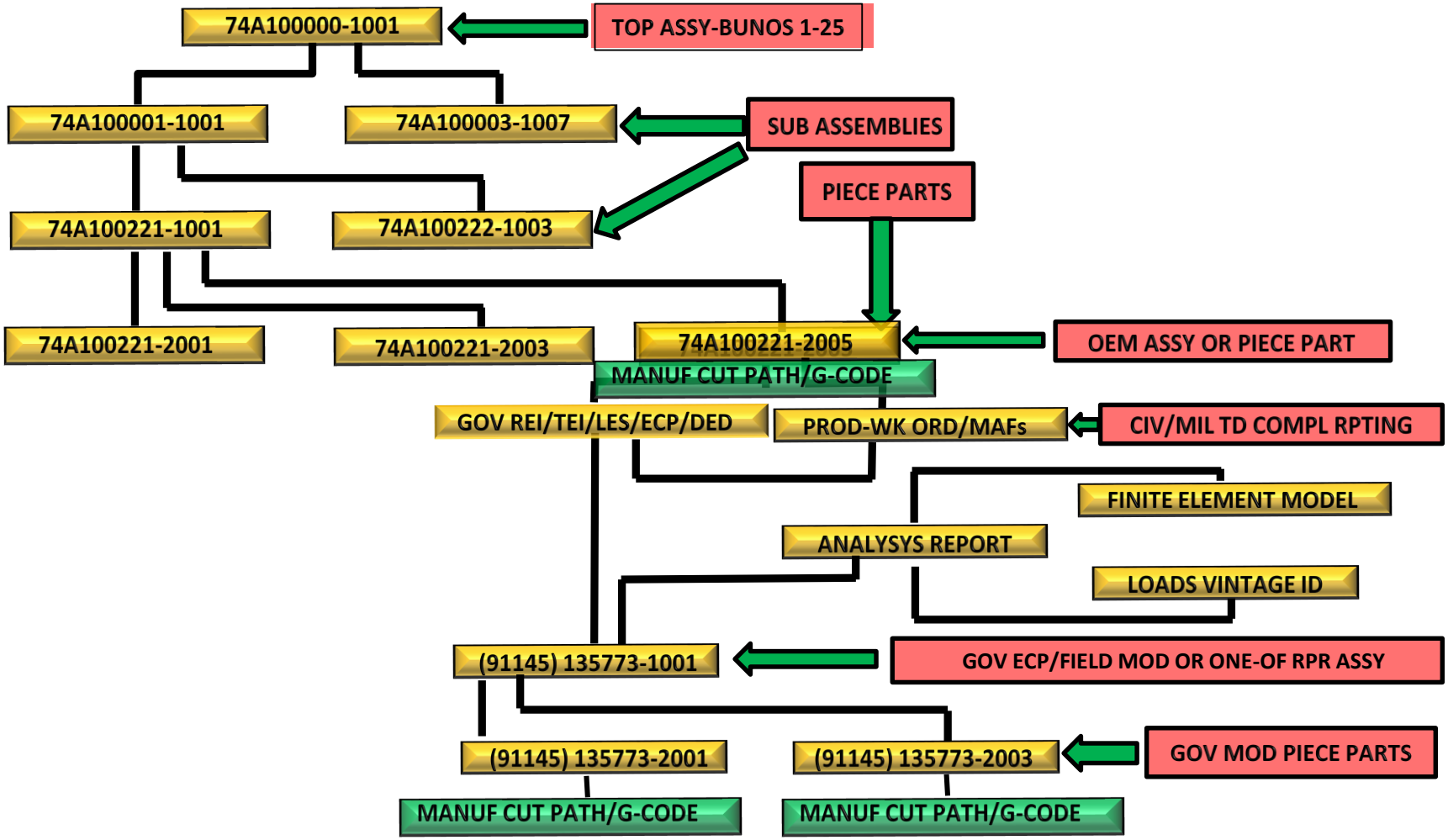
Example: F-18 Data Structure from Boeing

Government Part Association Scheme



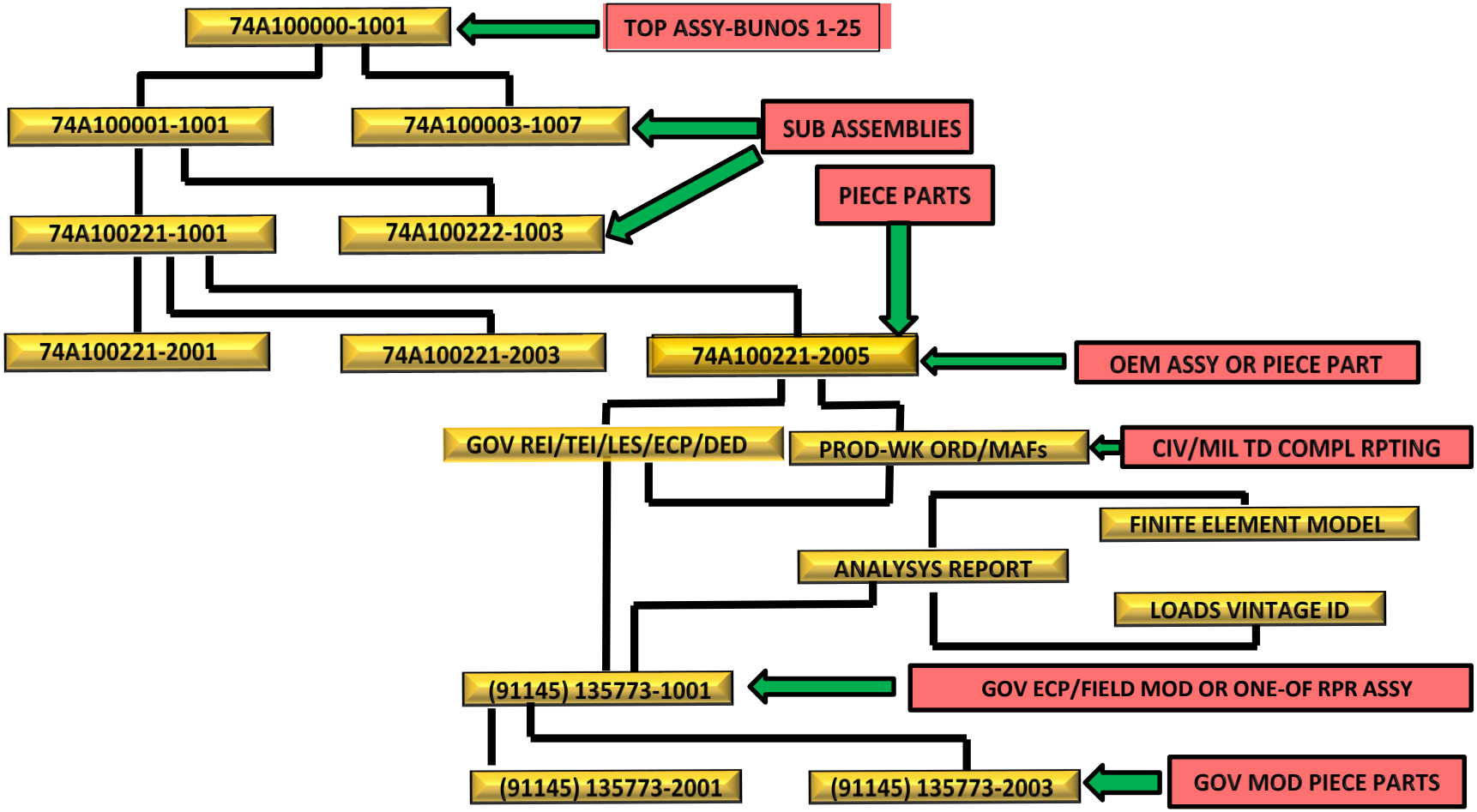
2014 CTMA Project Update

OEM and GOV Part Scheme Combined

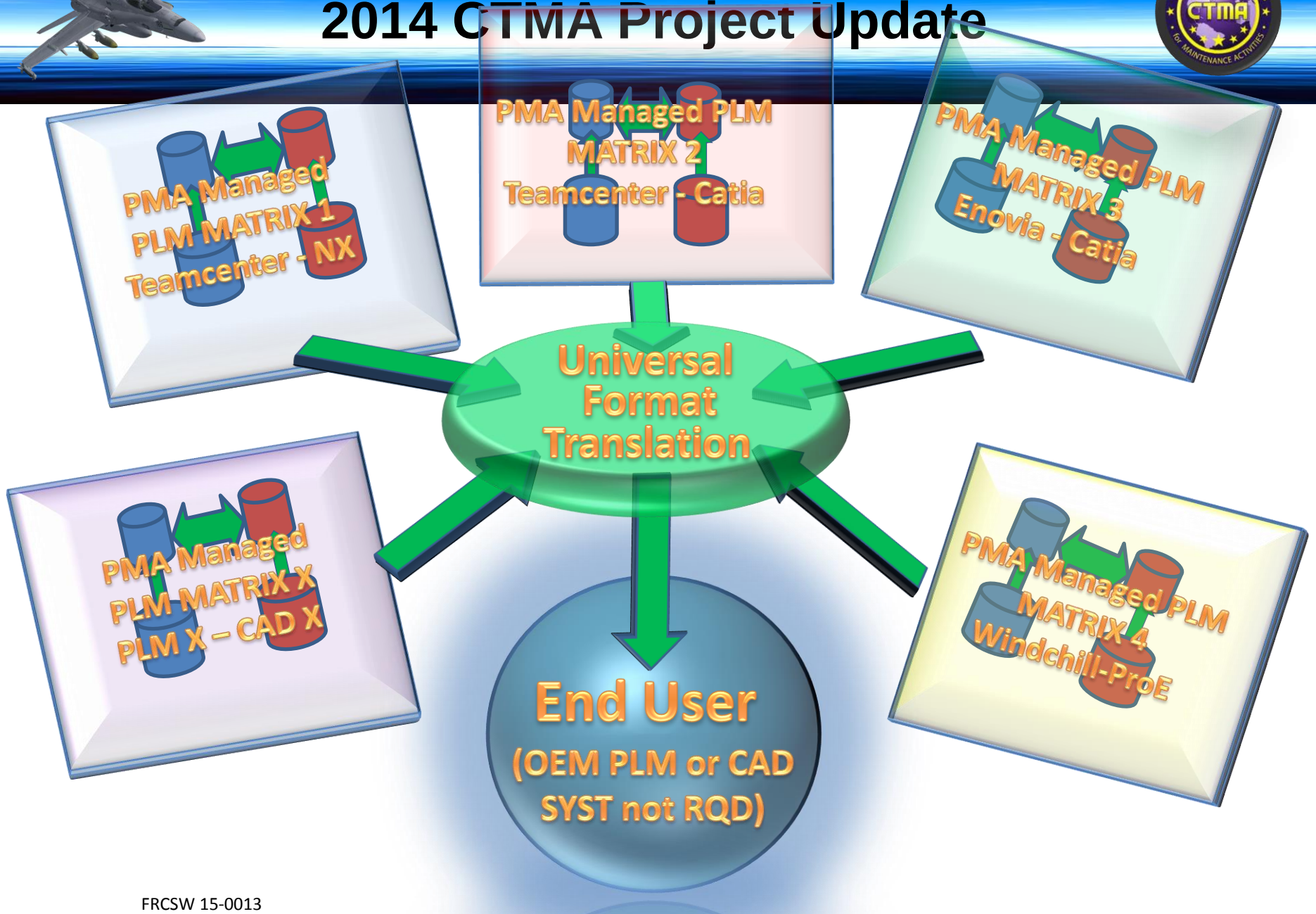


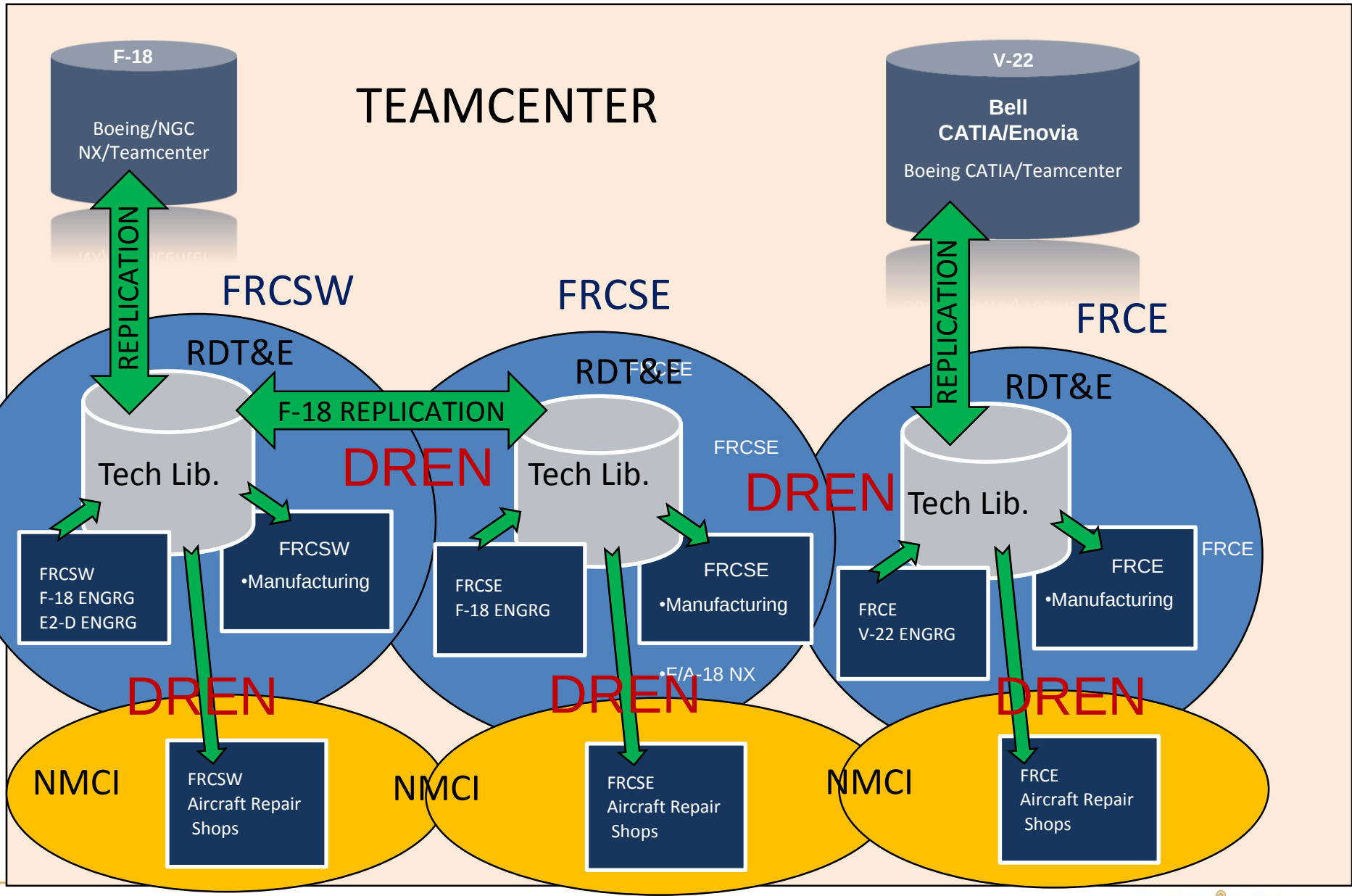
2014 CTMA Project Update

OEM and GOV Part Scheme Combined

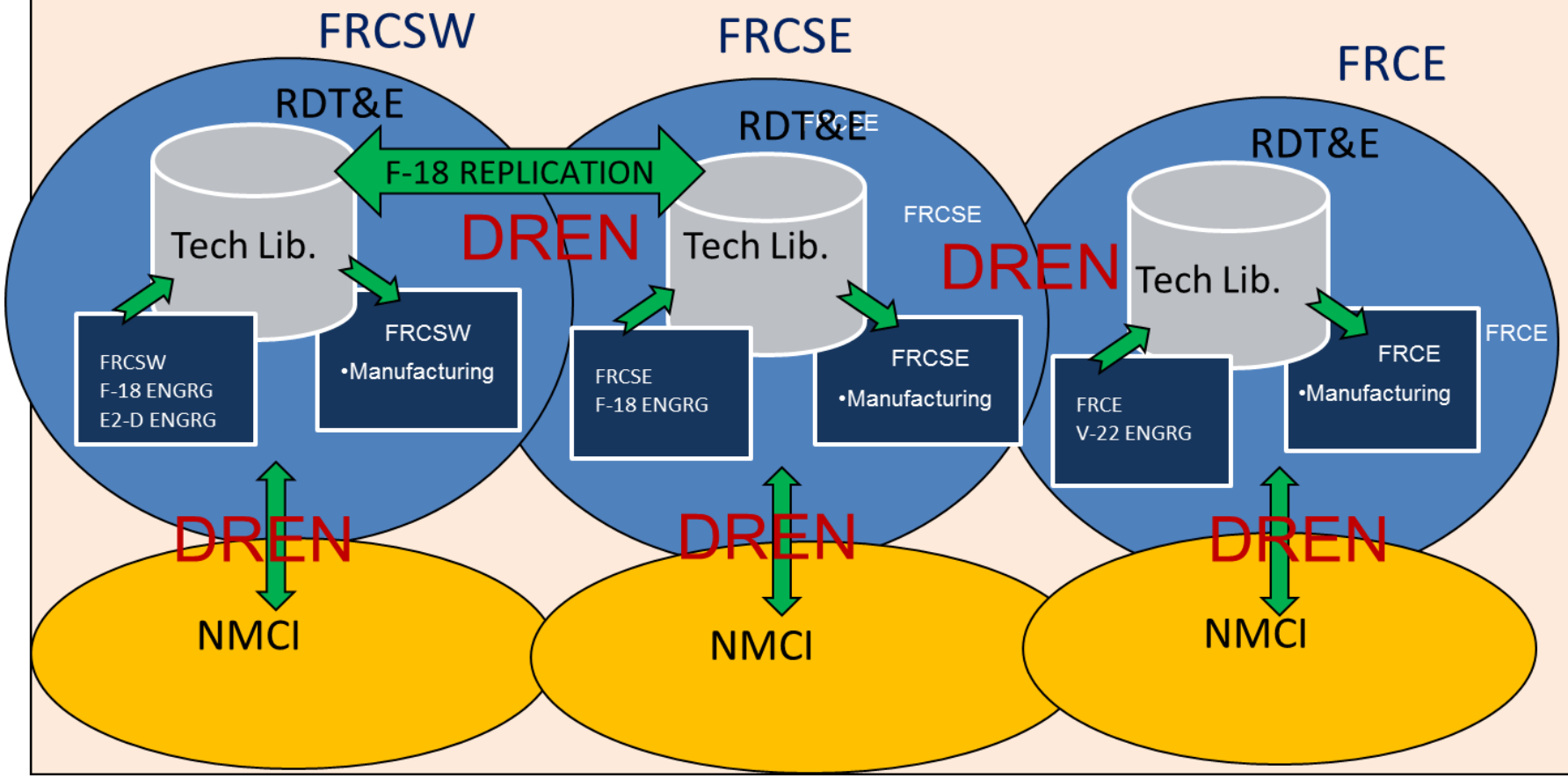


2014 CTMA Project Update




TEAMCENTER
F-18
Boeing/NGC
NX/Teamcenter
V-22
Bell
CATIA/Enovia
Boeing CATIA/Teamcenter
REPLICATION
REPLICATION
FRCSW
RDT&E
Tech Lib.
FRCSW
F-18 ENGRG
E2-D ENGRG
FRCSW
•Manufacturing
F-18 REPLICATION
DREN
FRCSE
RDT&E
Tech Lib.
FRCSE
F-18 ENGRG
FRCSE
•Manufacturing
•F/A-18 NX
DREN
FRCE
RDT&E
Tech Lib.
FRCE
V-22 ENGRG
FRCE
•Manufacturing
FRCE
DREN
DREN
DREN
NMCI
FRCSW
Aircraft Repair
Shops
NMCI
FRCSE
Aircraft Repair
Shops
NMCI
FRCE
Aircraft Repair
Shops

COMFRC PLAN TEAMCENTER PDM SOFTWARE OPERATING ON RDT&E COMMUNICATED TO NMCI VIA PORT 443 OR BETTER METHOD POSSIBLY VIA DMZ



Questions?

JTEG Tech Forum

30 June 2015

3D PDF as TDP at NAWC - Lakehurst

John Schmelzle
NAVAIR

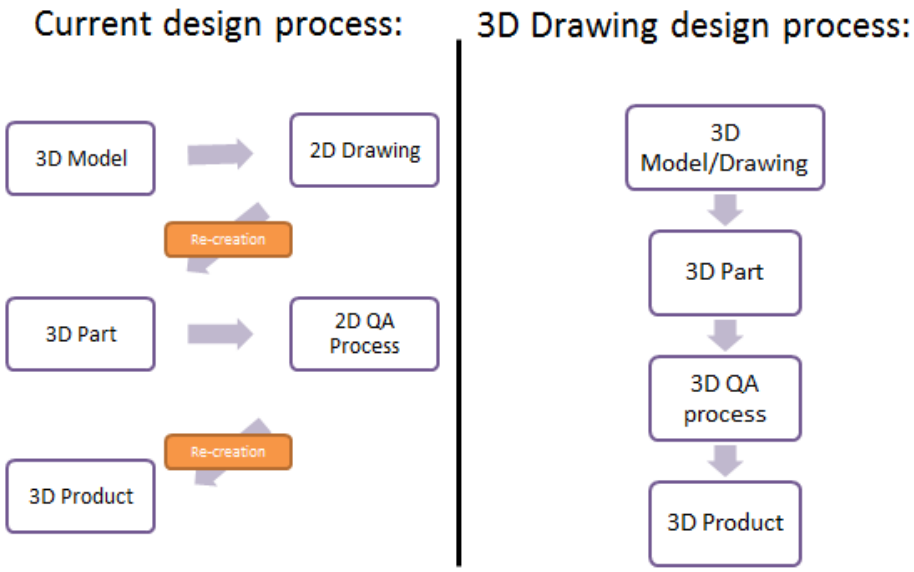
Agenda

- Driving requirements for 3D Technical Data for downstream consumption
- NAWC – Lakehurst approach (What we've done)
- Expected Benefits
- Future Plans – Next Steps

Driving Requirements

Current Process:

- Multiple translations
- Potential for introduction of human error



3D TDP Process:

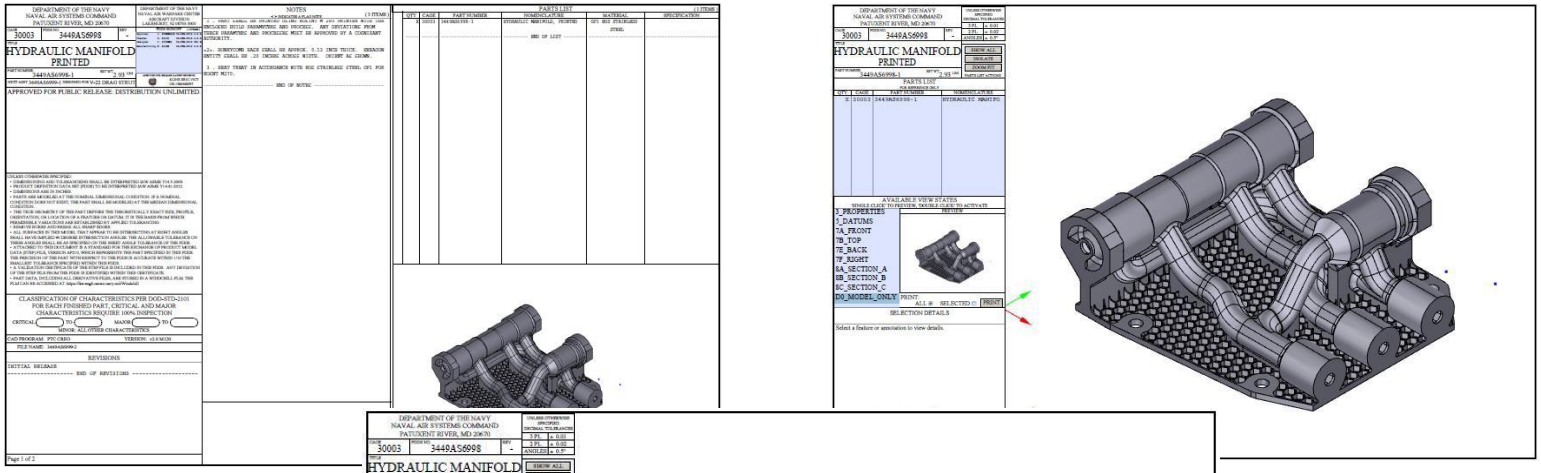
- Model data is leveraged across Manufacturing / QA / Logistics activities
- Drives requirements for accurate end-state model data

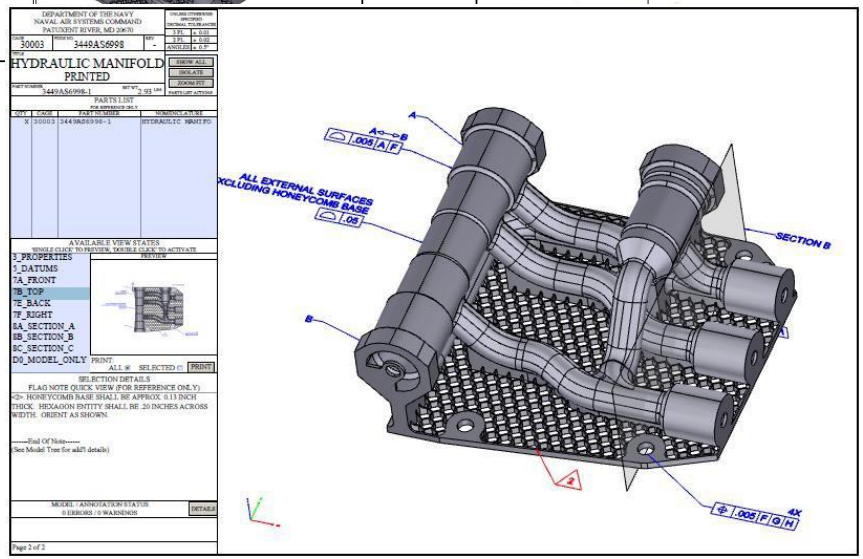
NAWC – Lakehurst Approach

3D Portable Document Format

- Neutral File Format
- In Accordance with ASME Y14.41
  - Need to Publish/Approve
- Readily Readable Format
- Compatible with existing DoD Systems for Technical Data management
- Long Term Archiving and CAM compatibility
  - Embedded STEP

NAWC – Lakehurst Approach





Adobe Acrobat Document

Expected Benefits

Activity	Monetary	Non-Monetary
Engineering	• Save labor by reusing CAD Data in interfacing designs • Reduced in-process design change due to engineering oversight (validation)	• Reduced design lead-time for new designs • Consistent processes
Manufacturing / Quality Assurance	• Save labor by reuse of CAD Data for CAM/CMM applications • Cost of rework (materials / labor)	• Maintained schedules • Robust data management
Logistics	• Save labor by reuse of CAD Data for IPBs and other logistics documents	
Overall	• Reduced re-work	• Improved communication • Configuration control

Next Steps

- Automating the generation of 3D PDF and model validation within PLM Systems
- Enabling more automated digital digestion of CAD data in downstream processes
  - Manufacturing, Quality, Maintenance
- Implementing TDP requirements to manage and facilitate advanced manufacturing methods
  - Additive / Digital Manufacturing

Questions?

Digital Thread and Model Based Environment JTEG

Top Ten Reasons to Care about Cybersecurity

25 June 2015

Dan Green
Director
Joint Advanced Manufacturing Region (SW)
SPAWAR 5.0

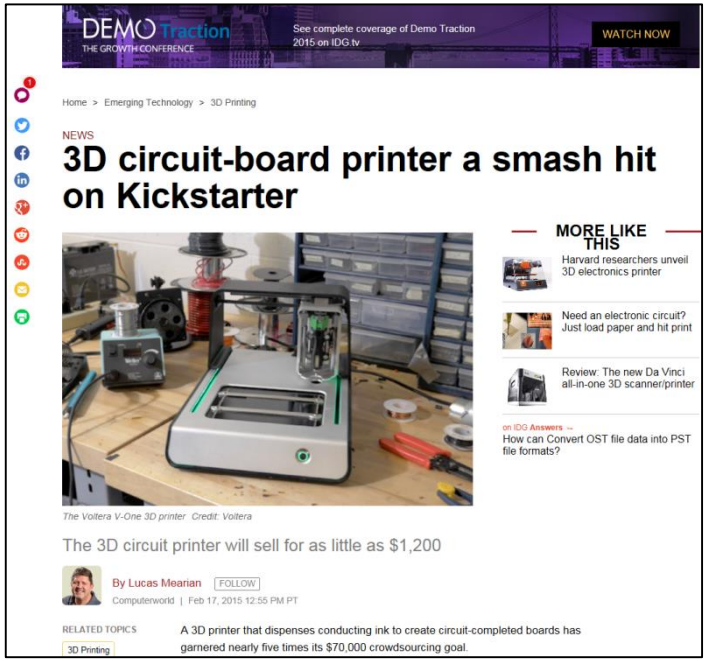
dan.green@navy.mil

Tasking

- **Task from AT&L**
  - "Talk about cybersecurity but don't try to scare everyone with fear, uncertainty and doubt (FUD)."
- **Approach**
  - Top Ten Reasons to Care About Cyber Security …with voice over.

Number 10

Robots need love too



Challenge: Connected Intelligent Device Management

Number 9

Kaboom will not get you promoted

THINGS CAN GO KABOOM WHEN A DEFENSE CONTRACTOR'S 3-D PRINTER GETS HACKED

By Aliya Sternstein
September 11, 2014
1 Comment

MakerBot Replicator 2X 3D desktop printer is on display at the MakeBot booth at the International Consumer Electronics Show in Las Vegas. // Jae C. Hong/AP

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Email this article
Increase size

Defense companies that manufacture parts with three-dimensional printers using metal powders might want to heed forthcoming government-issued standards for preventing hacks.

Not only can attackers steal proprietary designs by breaching the machines' data files – but they can also cause physical damage to production plants and employees.

NEXTGOV NEWSLETTE
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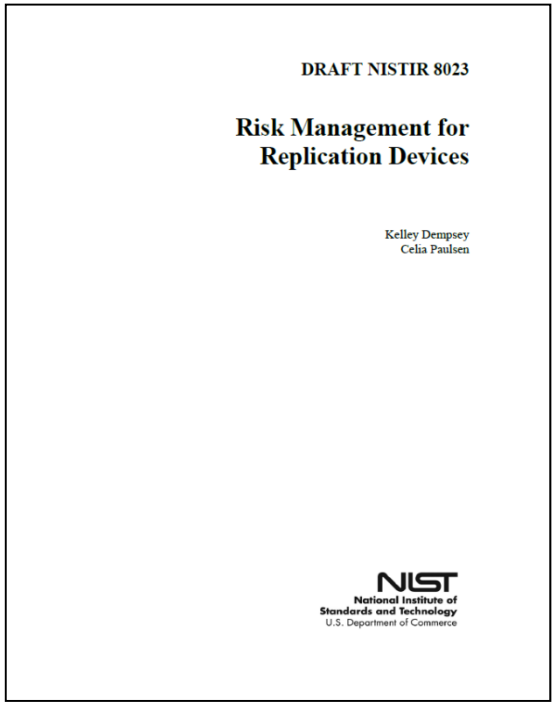
The Number of Industries Getting Classified Cyberthreat Tips from DHS Has Doubled Since July
8 Comments

SpaceX Is Bringing Mice, X-Rays and 3-D Printers into Space

97 Percent of Key Industries Doubt Security Compliance Can Defy Hackers



DRAFT NISTIR 8023

Risk Management for Replication Devices

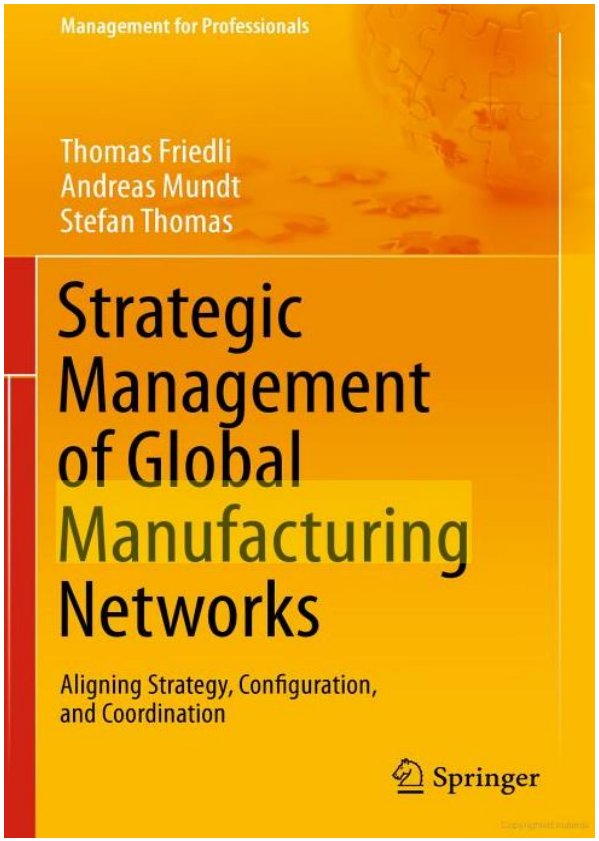
Kelley Dempsey
Celia Paulsen

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

Challenge: Cyber-Physical Systems

Number 8

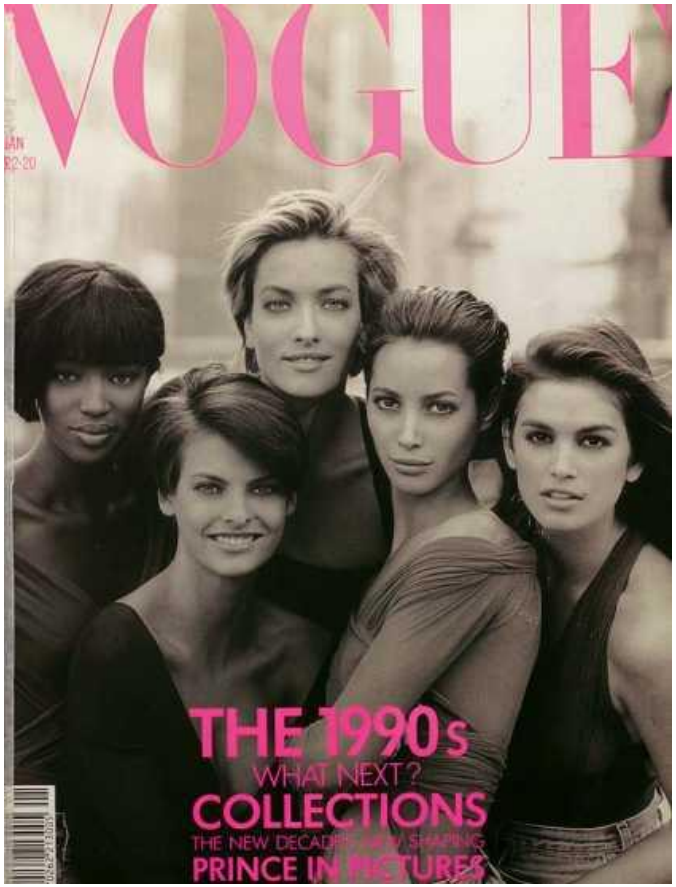
This is not your father's network



Challenge: Global Supply Chain Risk Management

Number 7

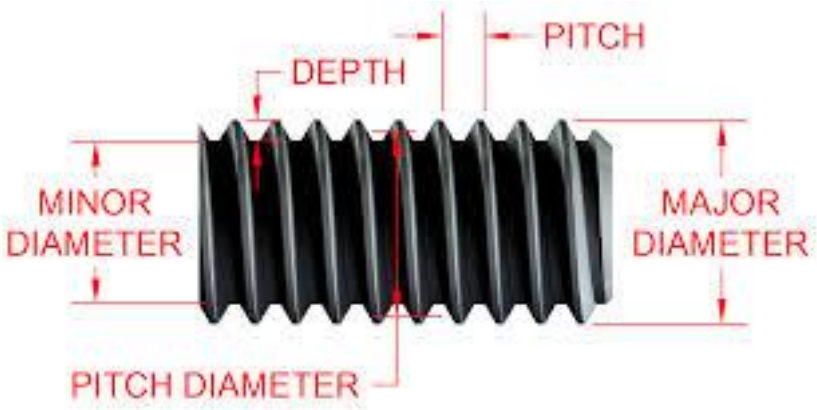
Super Model-Based Engineering Is In Vogue



Challenge: Long Term 3D Content Management

Number 6

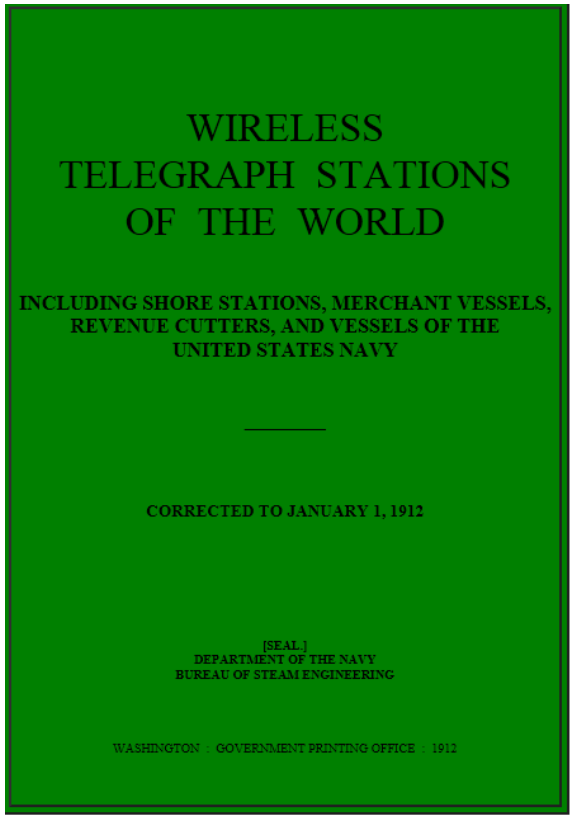
Use the wrong digital thread and you're screwed



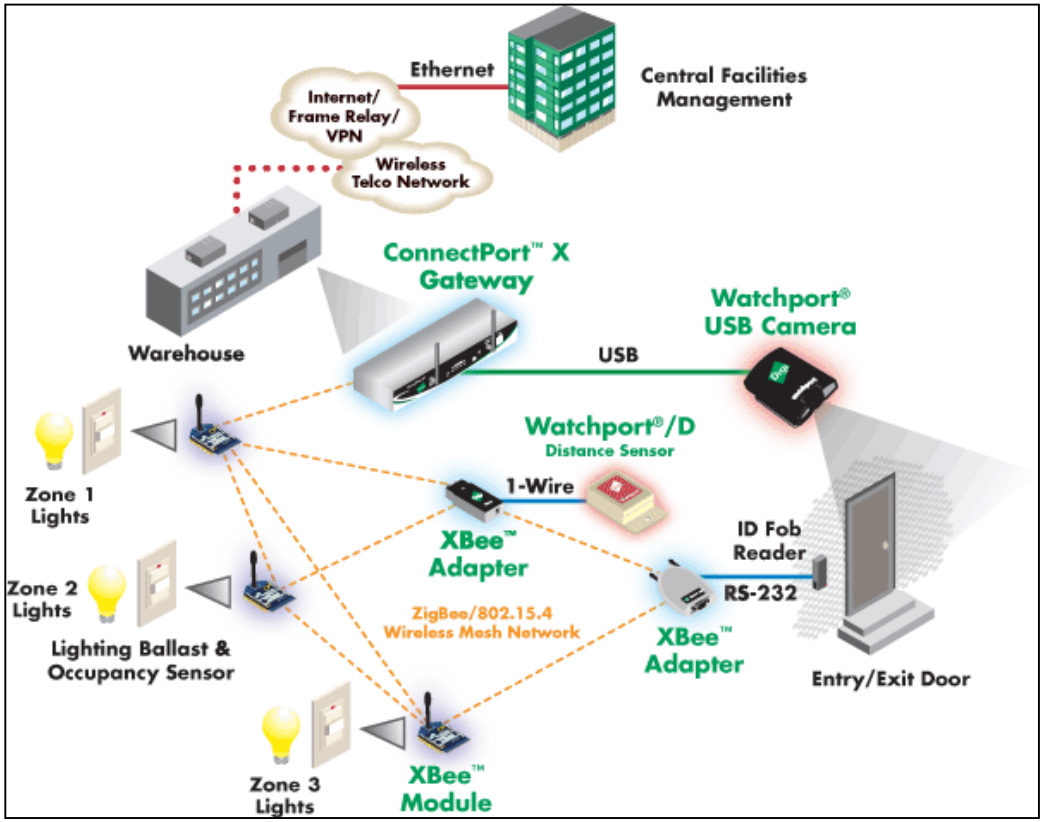
Challenge: Dynamic Digital Thread Workflows

Number 5

Wireless: It's not just for 'break-break' anymore



1912 Navy Wireless

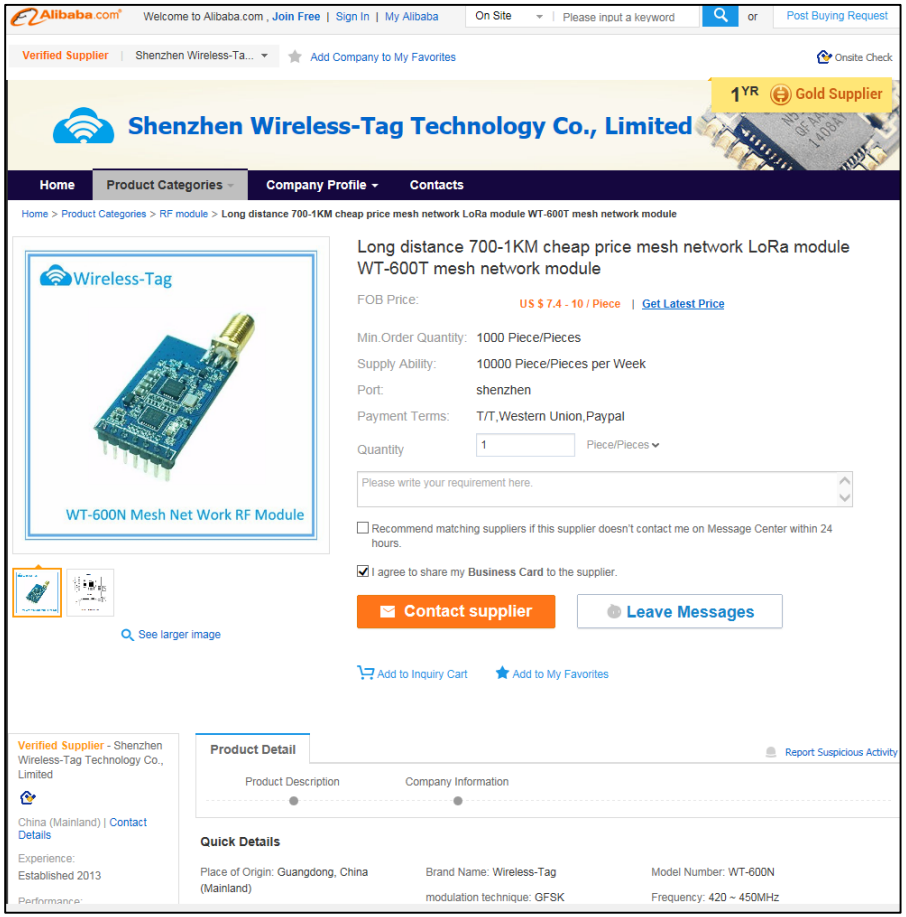


2012 Wireless

Challenge: Spectrum Management

Number 4

Sensors are eating the world



Challenge: Ubiquitous Passive and Active Sensing

Number 3

You are *in* the network not on it

The INTERNET of THINGS

Challenge: Human Machine Interfaces, Mobile and Wearables

Number 2

There are no SMEs

Don’t be fooled by cheap imitations…

Challenge: Cyber domain evolves continuously

Number 1

OPM has given away all our personal data so we might as well try to protect the machines

Challenge: Cybersecurity Readiness

Discussion

- **Opportunities**

- **Way Ahead**

Questions?

JTEG Joint Technology Exchange Group

Joint Solutions for Depot Maintenance

Digital Thread and Model Based Enterprise (MBE)

Review & Wrap-Up

30 June 2015

JTEG Joint Technology Exchange Group

Joint Solutions for Depot Maintenance

Next Month's JTEG Teleconference

Topic:

Additive Manufacturing Update

28 July 2015