ATC DE/DT Project
AUTOTESTCON
Discussion Panel
August 2023

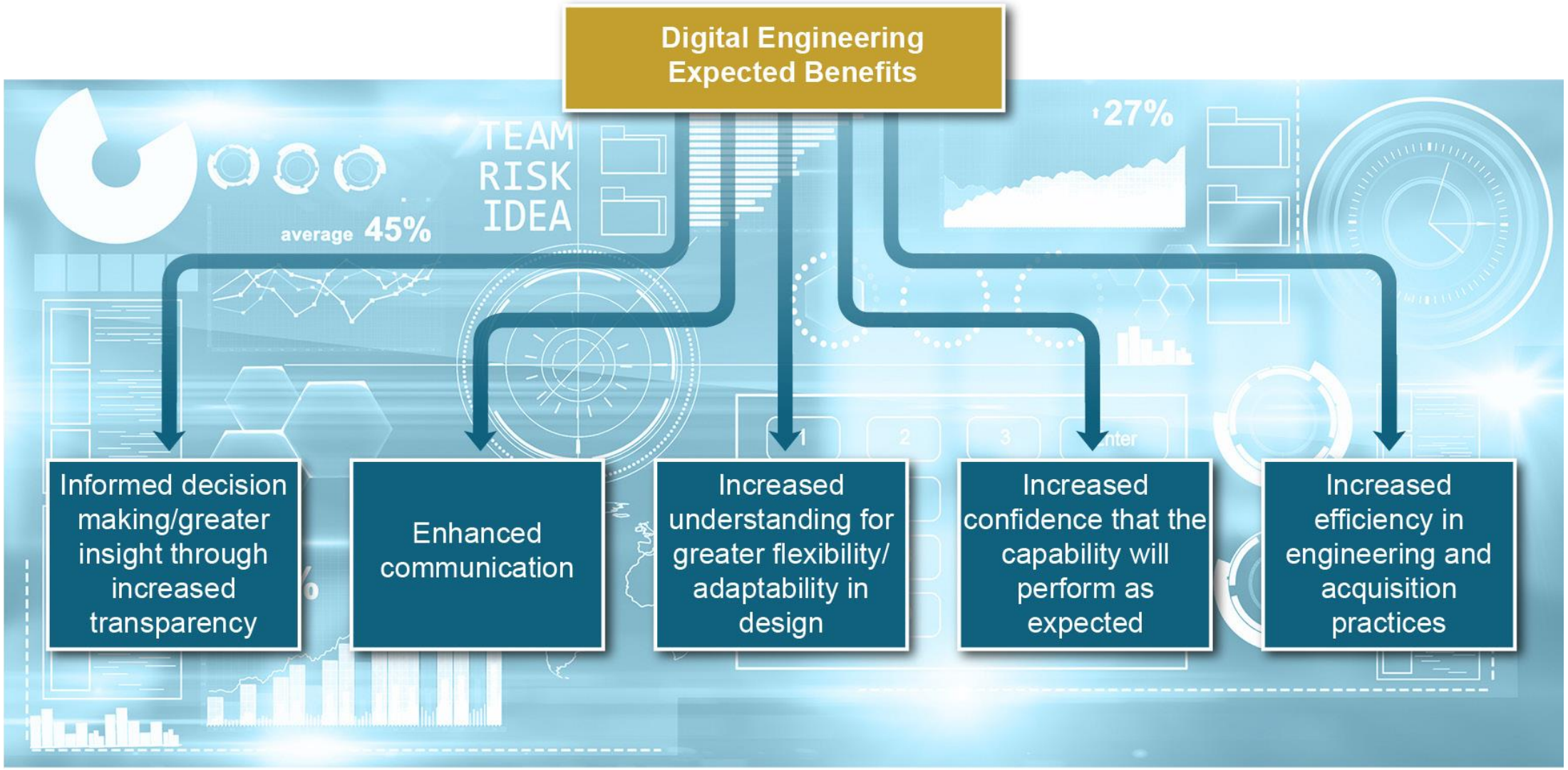
Problem Statement

Driving force behind project was presentation at 2022 ATC Plenary Session

- The DoD and the ATE industry needs faster and less expensive methods to develop, deploy, and sustain automated test solutions.
- The DoD Digital Acquisition mandate is pressuring government acquisition organizations to emplace processes that deliver digitally acquired digital products.
- The industry lacks definition of the digital acquisition process as it relates to ATE and Digital Engineering / Transformation.
- What is the current state of industry to support an ATS Digital Product Model and Acquisition?
- What are the insights Industry may provide to support our DoD ATS partners with their Digital Engineering and Acquisition needs?

Deliver a document for DoD reference that provides insights into the ATS/ATE Defense Industry's capabilities and potential improvements to support Digital Acquisition and the necessary execution of Digital Engineering and Digital Transformation.

Digital Engineering Expected Benefits



Source: U. S DoD, Digital Engineering Strategy, June 2018

DoD Automated Test Systems (ATS) Goals

- Reduce ATS total ownership cost by minimizing the proliferation of unique test systems and standardizing on designated ATS families.
- Reducing ATS logistics footprint enhancing warfighter's ability to rapidly deploy support in the modern conflict scenarios
- Improving quality of diagnostics and fault isolation reducing time to test, repair and return to service failed systems.
- Creating ATS interoperability/transportability within and across Services.

Note: DoD Automated Test System Executive Directorate Office, 7 Mar 2023; USAF Management Board Chair, Mr. Scot McClain

Project Mission and Goal

- Mission: Provide NDIA with a paper/presentation on where test industry is on this subject

  Provide recommendations to the government on how the ATE industry can support Digital Engineering and Digital Transformation, specifically the process, approaches, models, tools, and standards by which the automated test equipment and test programs are developed, acquired, and maintained through Digital Acquisition.

- Goal: Indicate the state of Model Based System Engineering tools and processes within the Automated Test Industry and the Standards used by this industry, along with expectations from government on DE/DT and the Digital Acquisition process.

Help the government understand/gauge industry's response to a digital acquisition using MBSE, tools and the standards by which to convey the digital product.

Aspirational Outline of Project Deliverable

- Executive Summary

- The Digital Engineering / Digital Transformation (DE/DT) Project
  - DE/DT Definition
  - Why it's important to the industry. What's the vision?

- Automatic Test System Workflows
  - Contracting and program management – Exchange of technical data, requirements definition & traceability, costing, schedule, etc.
  - Technical – Design, documentation, sustainment, operational data management and analytics
  - Reliability, Maintainability, Testability, Producibility, Human Factors, and Safety

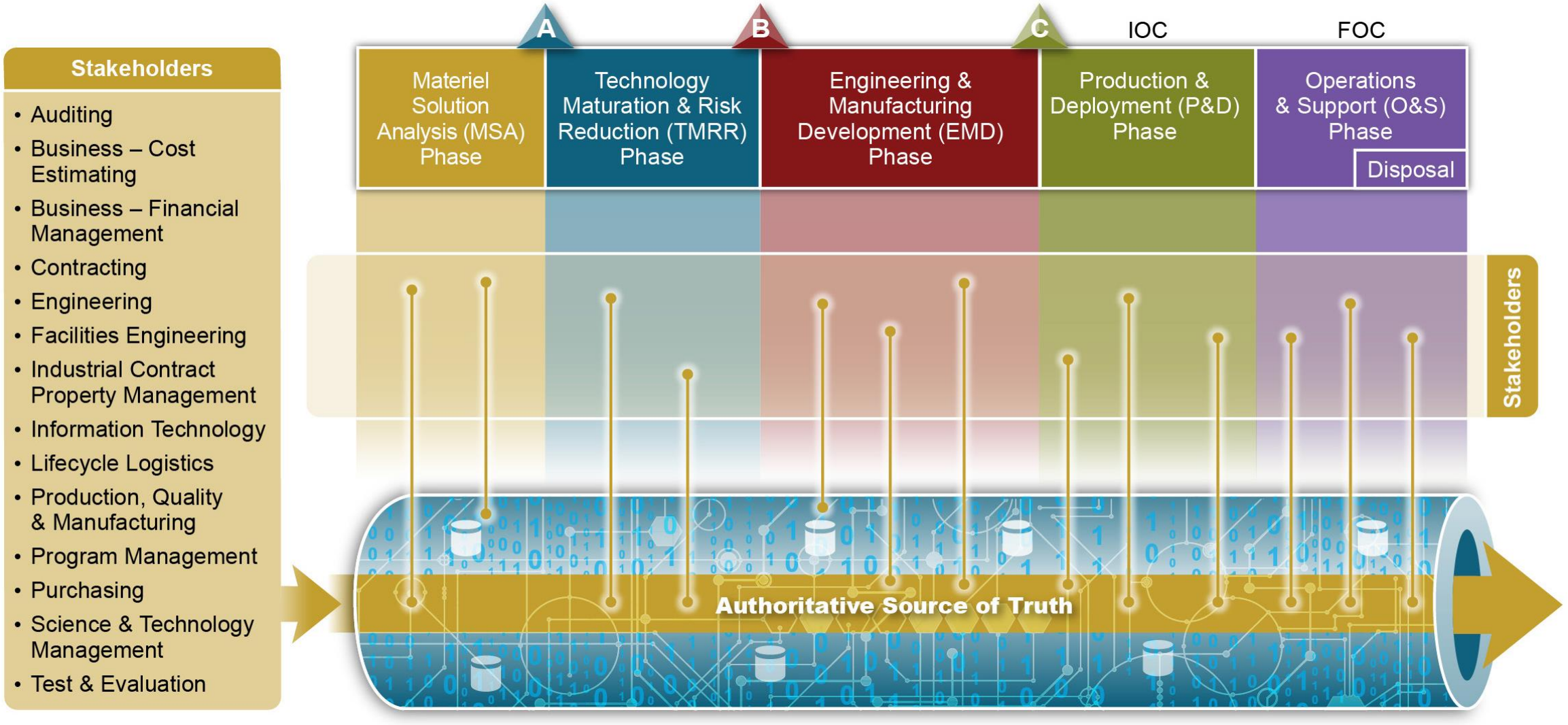
Project Deliverable Outline cont.

- Process/Digital Tools (and gaps) for accelerating and automating workflows
- Data Storage/Cloud and Cybersecurity for Digital Transformation and Acquisition
- Life Cycle Support, Sustainment and Logistics Considerations
- Conclusions. Next steps. What's needed in industry to realize the vision?
- Acronyms

Project Committees

- **Process/Digital Tools**
  - Pin Anupongongarch
  - Greg Brown
  - Greg Rossow
  - Maddie Dzuik
- **Standards**
  - Darcy Smith
  - Anand Jain
  - Mike Malesich
  - Tony Irwin
  - Jim Orlet
- **Life Cycle Support and Logistics**
  - Bruce Petty
  - Pat Griffin
  - Chad Lowe
- **Data Storage/Cloud & Cybersecurity**
  - Heath Causey
  - David Carey
  - Kevin Laudano
  - Rob Borrelli
  - Jamie Cha
  - Razia Qasim
- **Project Management**
  - Alan Lopriete
  - Tim Stanley

DoD Digital Engineering Visions



Source: U. S DoD, Digital Engineering Strategy, June 2018

Some Definitions for Common Ground with Project

- Digital Engineering

  Using Under Secretary of Defense for Research and Engineering (https://ac.cto.mil/digital_engineering): "*Digital engineering is an integrated digital approach using authoritative sources of system data and models as a continuum throughout the development and life of a system. Digital engineering updates traditional systems engineering practices to take advantage of computational technology, modeling, analytics, and data sciences*."

- Digital Transformation (varied inputs, all themes from DoD strategy for a fully digital environment and acquisition process)

  Digital transformation is the adoption of digital technology by an organization to digitize non-digital products, services or operations.

- Digital Acquisition (in alignment with adoption of Digital Transformation and providing digitized products)

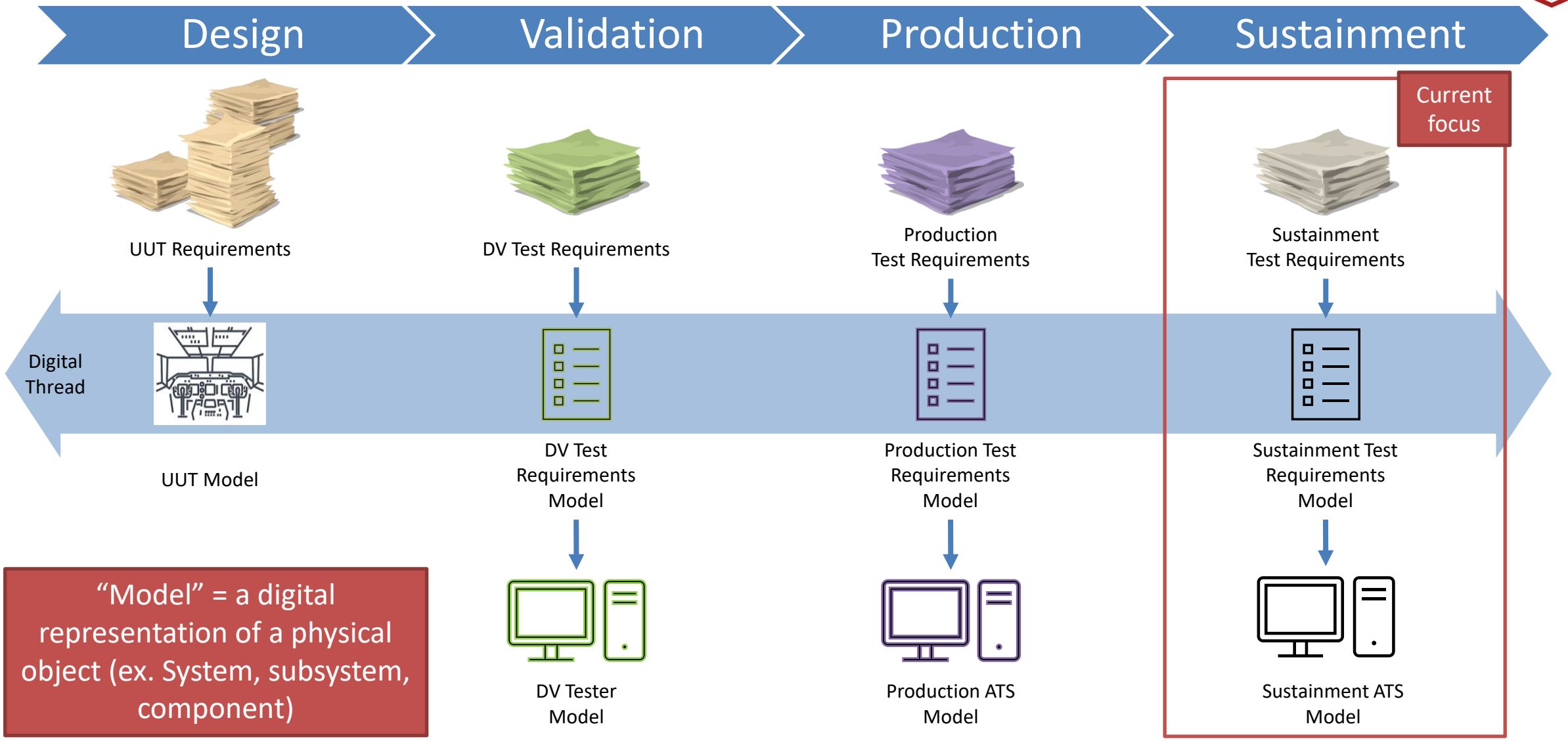
  Process of using digitally described products, that includes detailed digital models of the products for procurement, sustainment, and management of the product life cycle.

- Model Based System Engineering (MBSE): INCOSE defines MBSE as the formalized application of modeling to support system requirements, design, analysis, verification and validation of activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases.

Processes & Tools and Standards Topics

- Digital Engineering across UUT life cycle
- Focus of Pre-AUTOTESTCON Efforts
- Models & Tools used as part of Digital ATE acquisition process
- Review of Current “Gaps”

Digital Engineering Across UUT Life Cycle



"Model" = a digital representation of a physical object (ex. System, subsystem, component)

Focus of Pre-AUTOTESTCON Efforts

DoD & Industry Acquisition-related Activities

- **Models & Tools used as part of Government pre-acquisition processes**
  - Prior to releasing RFP to industry

- **Models & Tools used as part of Industry response to RFP**
  - Proposal generation

DoD Pre-Acquisition Vision

(translated from PMA260 2019 Autotestcon Presentation)

Requirements Collection

1

Create/collect UUT test requirements

UUT/ATE Definition

2

Analyze test capabilities vs requirements (UUT vs ATE)

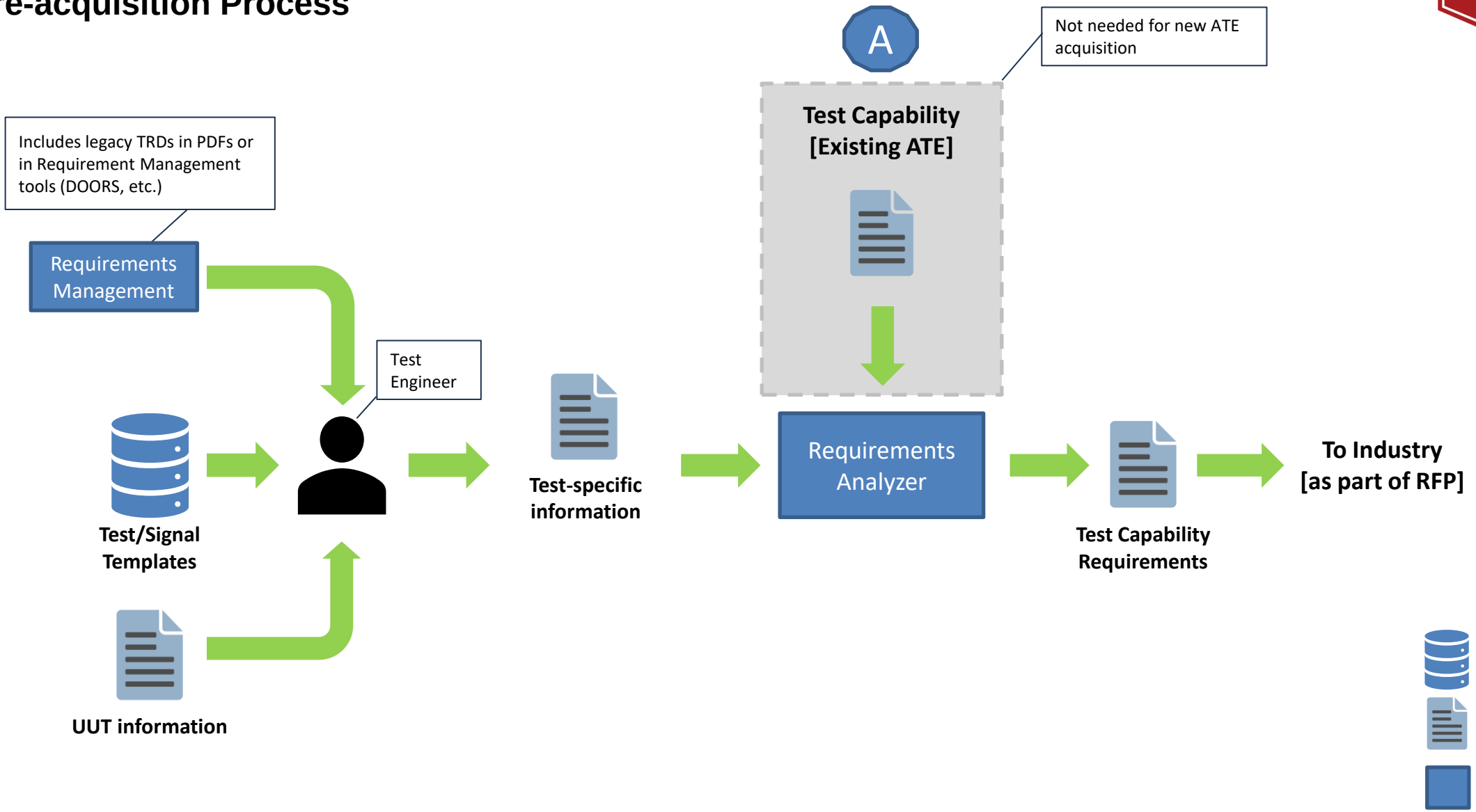
RFP Development

3

Develop RFP using analysis results

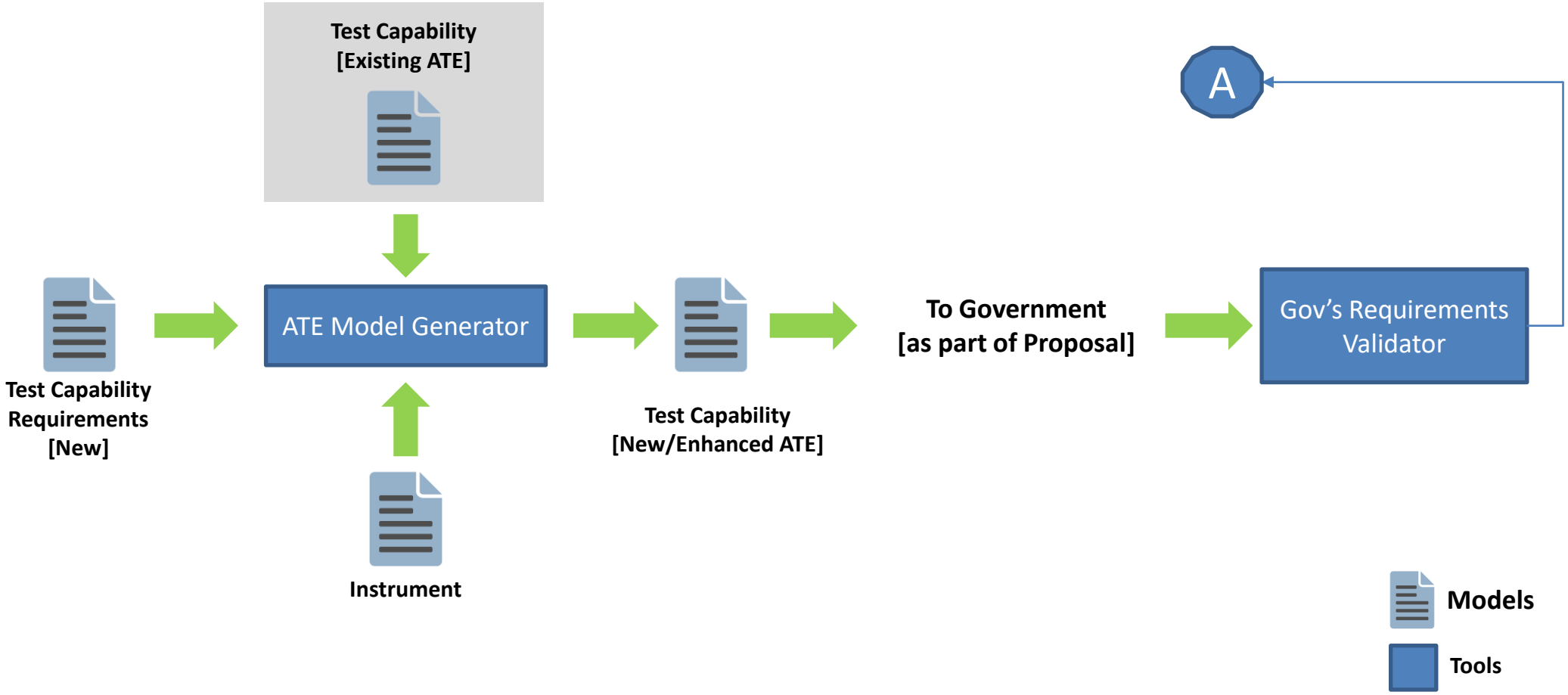
Digital Acquisition Workflow

DoD Pre-acquisition Process



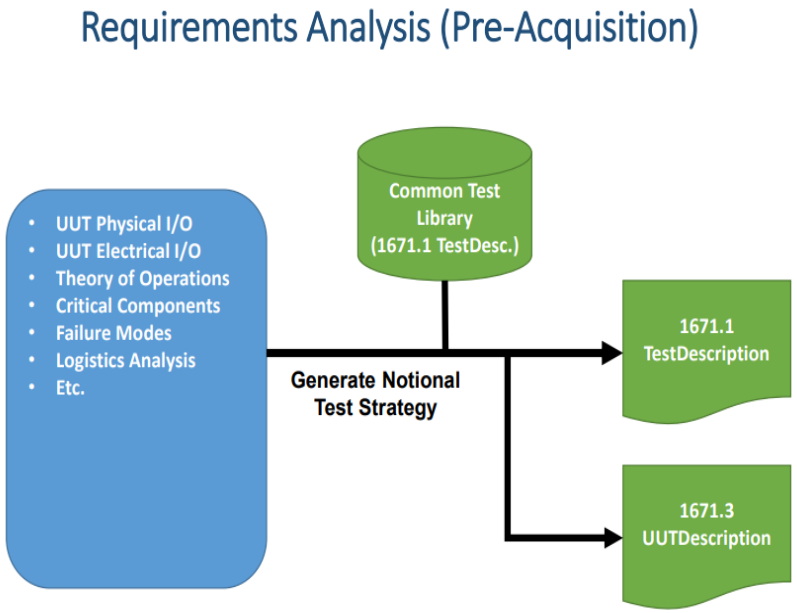
Digital Acquisition Workflow

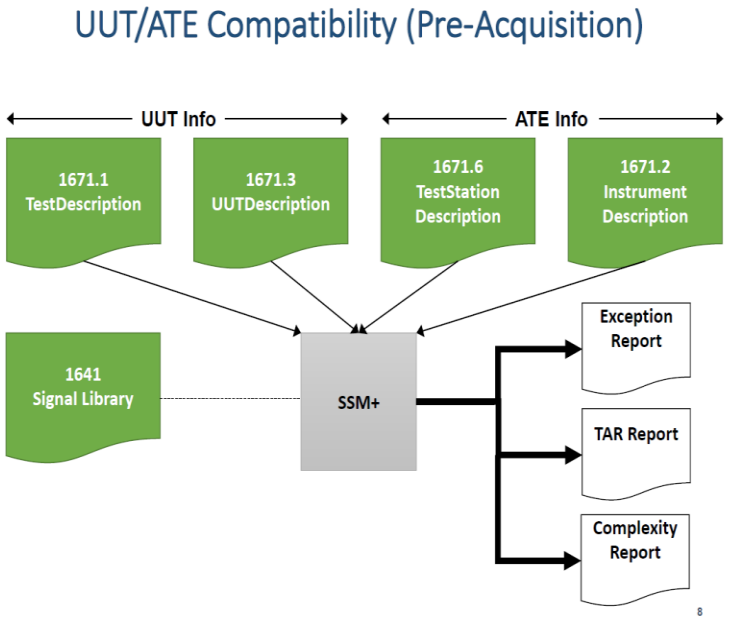
Industry Response to RFPs (Proposal Generation)



Modeling Standards

- **Modeling standards considered thus far**
  - SysML: Used by DoD & primes for UUT modeling
  - ATML: Used widely for test-specific modeling
- **Standards groups not yet reviewed**
  - IEEE Systems Council: Committees are resource for system engineering documents or guidelines
  - Digital Twin Consortium Part of OMG (Object Management Group): Industry & Government craft interoperable technology standards

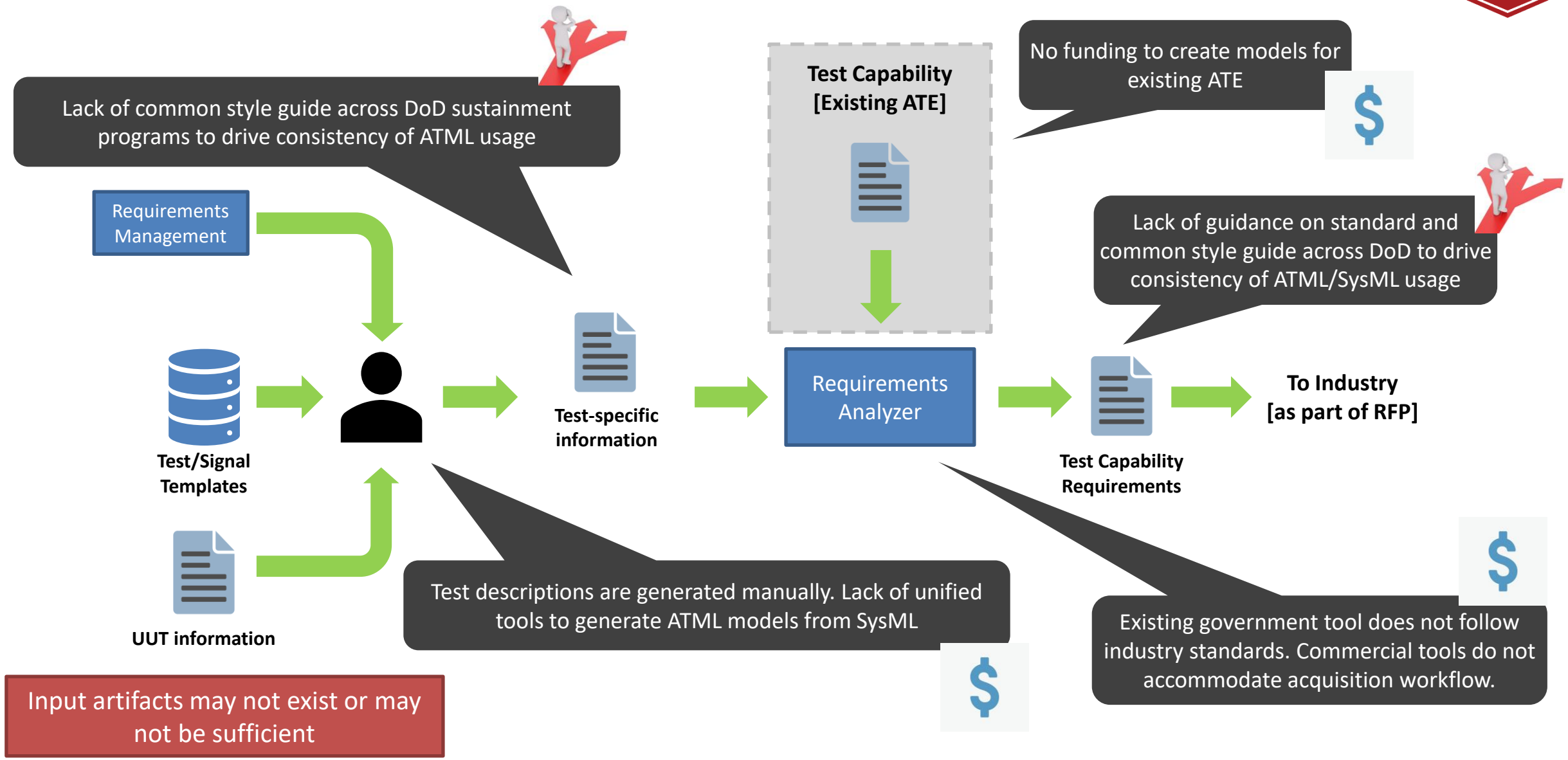




WHERE ARE THE GAPS?

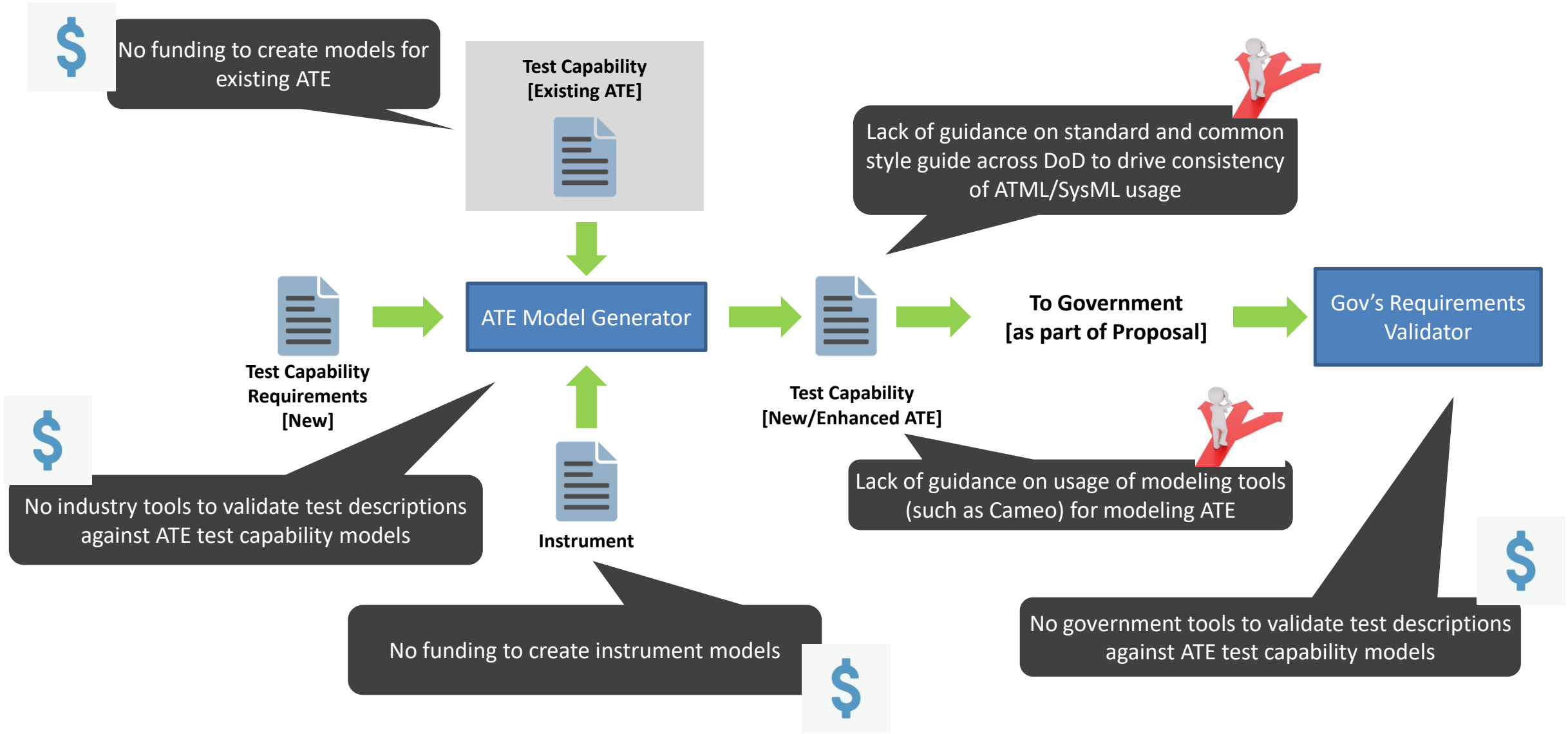
Digital Acquisition Workflow – Gaps

DoD Pre-acquisition Process



Digital Acquisition Workflow – Gaps

Industry Response to RFPs (Proposal Generation)



SUMMARY & RECOMMENDATIONS

Summary & Recommendations

- **Develop common style guide for ATML/SysML usage across DoD (sustainment) programs**
- **Supply guidance on preferred tools (such as Cameo or other) for modeling ATE & instruments**
- **Provide funding vehicles for**
  - ATE system models & instrument models
  - Digital engineering environment able to accommodate multiple data formats as defined by the digital acquisition workflow
  - Industry tools to analyzer and validate test requirements models against ATE test capability models

Contributors

- **Process and Tools Subcommittee**
  - Pin Anuponongarch, Teradyne – Lead
  - Greg Rossow, Keysight
  - Greg Brown, NI
  - Madaline Dziuk, Boeing
- **Standards Subcommittee**
  - Darcy Smith, Keysight – Lead
  - Anand Jain, NI
  - Michael Malesich, Navy NAWCAD
  - Tony Erwin, Teradyne
  - Jim Orlet, Boeing

Life Cycle Support and Logistics

Life-Cycle Support and Logistics – Introduction

Life Cycle Support and Logistics

- **Define**

  Life Cycle Support and Logistics (LCSL) should be an integral element during prime item development and subsequently, the Automated Test System (ATS) design and development.

  There will be those who believe this to be too early to consider LCSL. However, historically early consideration and planning of LCSL leads to program longevity, reduced cost and higher reliability.

- **Scope**

  ALL branches of the DoD. While there are differences in ATS management between all of them, the system of systems that is ATS can be shown as a digital acquisition and LCSL processes that take advantage of the offerings.

- **Target Org/Customer**
  a. **USAF** – *VDATS, CBATS, JSECTS*
  b. **US Army** – *NGATS*
  c. **US Navy** – *eCASS/CASS, ETI*
  d. **USMC** – *TETS/VIPERT, GPATS*

- **Digital Value Chain Management**

  Primary activities contribute to a product or service's physical creation, sale, maintenance and support.

- **Cost Impact**

  Pain Points of Digital Transformation drive cost and schedule impacts, 'initially'. As defined by the NDIA Systems Engineering Research Center.

Life-Cycle Support and Logistics – Obsolescence

Obsolescence

- **Change Definition** - *Obsolescence can stem from functional or physical elements of the ATS.*
- **Planning** - *The Planning phase of obsolescence management shall be characterized by validated requirements, milestone-based period of performance and the resources required to implement changes.*
- **Implement** - *The Design Change authority shall ensure that resources are available to execute the obsolescence management plan. Steps shall be taken to initiate procurement, hardware and software design changes, and all required support document, as well as develop training associated with the change.*
- **Test -** *Design verification through modeling, simulation, and test, is a critical step to establish that the modified ATS conforms to the established design criteria, while also maintaining the applicable performance established for the initial ATS configuration items, i.e., backward compatibility.*
- **Package -** *The final packaging configuration is coordinated with the Acquisition Authority to ensure compatibility with any higher order physical and function configuration items of the ATS.*

Technology Insertion (Future changes post transformation)

- **Roadmap Definition/Timeline** - *A technology insertion model shall be adopted to counter the effects of diminishing manufacturing sources and material shortages (DMSMS), which lead to obsolescence.*
- **Change Management -** *To counter the effects of obsolescence caused by DMSMS, and to keep pace with weapon system maturity, the Acquisition Authority will manage the Technology Insertion Roadmap that defines the synchronization cycle of the ATS and weapon system changes.*

Life-Cycle Support and Logistics – Configuration Management

Configuration Management (CM) is a technical discipline that ensures requirements, development, and operational information remains consistent throughout the program life cycle.

Artificial Intelligence

- *As Artificial Intelligence (AI) rises in use, the opportunity exists for Industry and the Government to use this technology.*
- *The proper method in maximizing this technology still needs to be determined. More discussion needs to take place to determine the greatest potential regarding configuration management.*

Enterprise Communication

The Configuration manager will be key in each individual group. This person will help point Integrated Product Teams (IPT) to guidance and regulations such as MIL-HDBK-61B, Configuration Management Guidance and others.

- **Cyber Security** *-At the moment, different cybersecurity requirements exist for each individual service. It will be essential that the Government works together internally to establish procedures that protect the data that will be collected and store as well as allow for access across different organizations that are not co-located.*
- **Digital Acquisition** - *The integrated digital environment will allow for various digital acquisition methods. It will allow for delivery of potential solutions in a digital format.*
- **Digital Engineering/Manufacturing** - *Models, artifacts, and processes will formulate the digital thread. The digital thread will be transportable from Industry to the Government and would facilitate reuse of information.*

Life-Cycle Support and Logistics – Tech Data and Documents

Technical Data Package and Documents

- **Drawings and Re-procurement Data** – *Defining the digital ecosystem will remain dynamic until differing MBSE methodologies and real world examples start to shape the bonified direction between design and Life-Cycle Support.*
- **3-D Digital Format and Tools** – *Directed by many standards, specifications and practices, the tools will settle on MBSE based tools for design, development and integration that supports the required 3-D rendering and formats.*
- **Technical Manuals, Orders and Supporting Documentation** – *Tools and standards should support fully automated documents. Markup languages should result in automated documentation generation and updates.*
- **Intra Connected System Wide** – *Long term life-cycle support and logistics should be intra connected enterprise wide for MBSE and automated updates and publishing.*
- *MIL-STD-3100B - MIL-HDBK-539 - MIL-STD-3022 - DI-SESS-82400 - DI-SESS-82380*

Life-Cycle Support and Logistics – Training

Virtual/Augmented Reality – *Enhanced training using operator directed input from V/A Reality as part of instructions, demonstration or cross check.*

Use of Digital Twin Models – *ATS to/from UUT Simulation using structure of Digital Twins threaded with either file or operator input to force GO/NOGO path allocation.*

HW in the Loop Simulations – *Further enhancement of simulation while using digital twins, by adding actual hardware UUT or ATS elements into the thread.*

Life-Cycle Support and Logistics – Priority Take Away

A change in a widget due to obsolescence or DMSMS issue…

Ohhh Nooo…

Currently and traditionally… changes would be buffered up and processed all at once or in logical batches.

What does the Digitally Transformed environment mean for long term Life Cycle Support and Logistics?? Main Point…

Life-Cycle Support and Logistics – Current Change Cycle

A Widget is replaced. The form is a bit different and a different part number... so:

1) Drawings must be updated, Redlined.
2) Redlined package must be reviewed and approved.
3) Drawings must be finalized and accepted.
4) Uploaded into the complete drawing tree structure and stored.
5) Documents must be manually identified and Redlined to include the change.
6) Redlines must be reviewed and approved.
7) Document Changes must be Integrated and Finalized and Accepted.
8) Documents must be Uploaded...
9) Training Material... (Same)

Timeline – 3 to 6 months (sometimes optimistic)

Life-Cycle Support and Logistics – DIGITAL Change Cycle

A Widget is replaced. The form is a bit different and a different part number... so:

1) The new Widget is modeled and defined.
2) SysML thread created for the new model and integrated as the replacement.
3) New Configuration is Reviewed and Approved.
4) Change is propagated through the TDP, Documents and Training Material.

Timeline – 30 to 60 days (Most of this time is spent in review and acceptance)

Cyber and the Digital ATS

Topics

- DoD Data Storage/Cloud and Cybersecurity Strategy
- Applying DOD Strategy to Digital ATE Acquisition Process
- Example of High Level CMMC 2.0 Compliance Direction
- Future Considerations

DoD Data Storage/Cloud and Cybersecurity Strategy

- The US Department of Defense Chief Information Officer (CIO) is responsible for matters in the area of cybersecurity, data storage, and cloud solutions as it applies to DoD organizations and industrial partners.
- The CIO provides guidance such as the DoD Digital Modernization Strategy, DoD Zero Trust (ZT) Strategy, and others.
- The CIO has developed the Cybersecurity Maturity Model Certification (CMMC) 2.0 to ensure partners in the Defense Industry Base (DIB) take appropriate steps to protect multiple levels of national security information.
- CMMC 2.0 aligns with NIST SP 800-171 which addressed the protection of controlled unclassified information (CUI) in nonfederal systems and organizations.

Applying DOD Strategy to Digital ATE Acquisition Process

- **The software tools, data, and cloud solutions used within the Digital ATE acquisition process will be subject to the CIO direction.**

- **In future procurement actions, DoD entities will define the level of CMMC compliance to participate in a contract. Limited time Plan of Actions and Milestones (POA&M) will be available to complete a subset of CMMC requirements after award. Waivers are available but will be rarely implemented.**

- **Automated test software and hardware providers, who are part of the OIB, are committing resources to be compliant with CMMC and would most likely resist any changes to this path.**

- **DoD organizations and partners involved with the ATE procurement process should refer to the CIOs guidance to implement the processes and procedures for cybersecurity, data storage, and cloud solutions.**

Example of High Level CMMC 2.0 Compliance Direction

Five Steps to Make Your Company More Cyber Secure

1. Educate people on cyber threats	Most cyber incidents start because of user error. Educate people about the importance of setting strong passwords, recognizing malicious links, and installing the latest security patches. Helpful materials and training videos are available through **Project Spectrum**.
2. Implement access controls	Limit information systems access to authorized users and the specific actions that they need to perform.
3. Authenticate users	Use multi-factor authentication tools to verify the identities of users, processes and devices.
4. Monitor your physical space	Escort visitors and monitor visitor activity, maintain audit logs, and manage physical devices like USB keys.
5. Update security protections	Make sure to download the latest security patches when new releases are available. Always double check to make sure they are coming from a trusted source.

Source: https://dodcio.defense.gov/CMMC/Implementation/

Future Considerations

- **Review and confirm the ability of ATML in the current format to comply with CMMC 2.0.**

- **Review the appropriate levels of CMMC classification to be considered for ATE SysML models and ATML files used in RFIs and other procurement actions.**

- **Consider any additions to the CMMC 2.0 guidance specific to the procurement process pertaining to automated test equipment.**

Next Steps

- Continue bi-weekly meetings to progress project
- Consolidate the committees inputs and results
- Get additional DoD and Industry feedback from ATC presentations
- Review other ATC presentations for additional material and relevant perspectives to support mission and goal
- Update current document outline
- Create first draft of deliverable document by end of year.