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U.S. Army Research, Development and Engineering Command
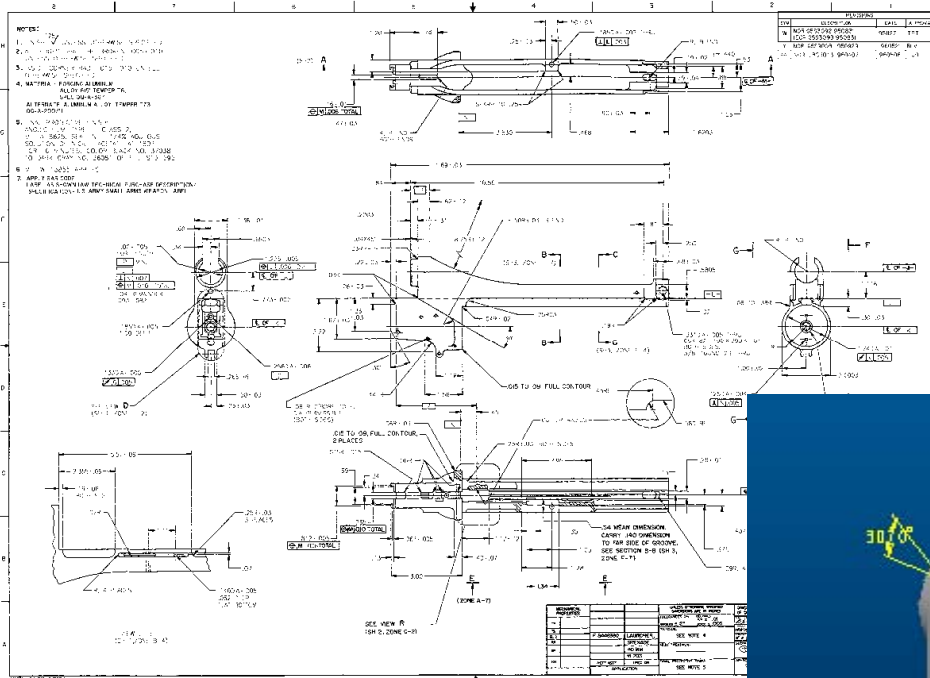
TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

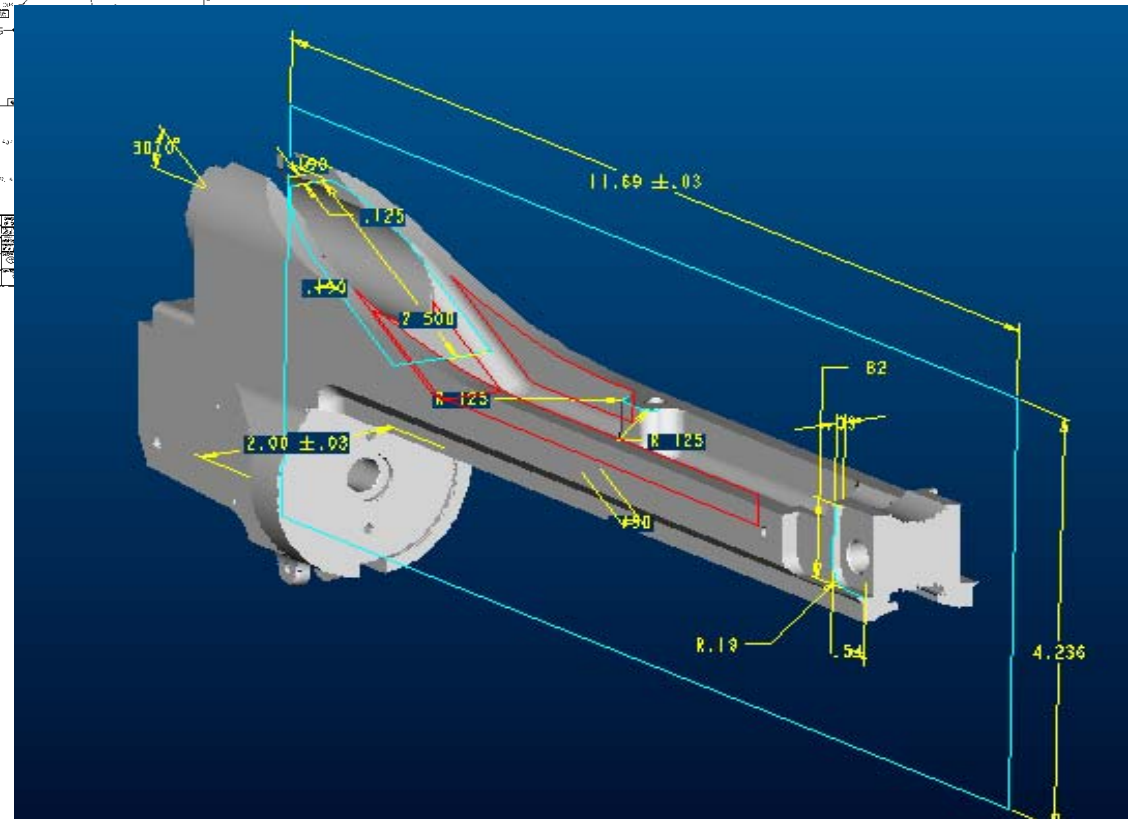**Technical Data Package Specification for 3D MBD
and MIL-STD-31000 Overview**

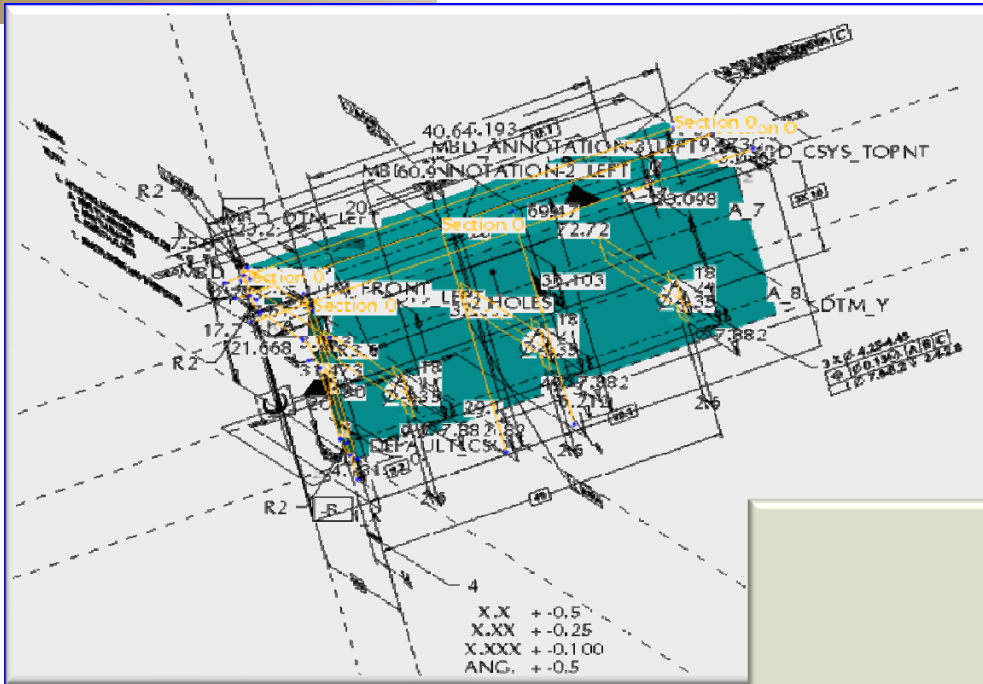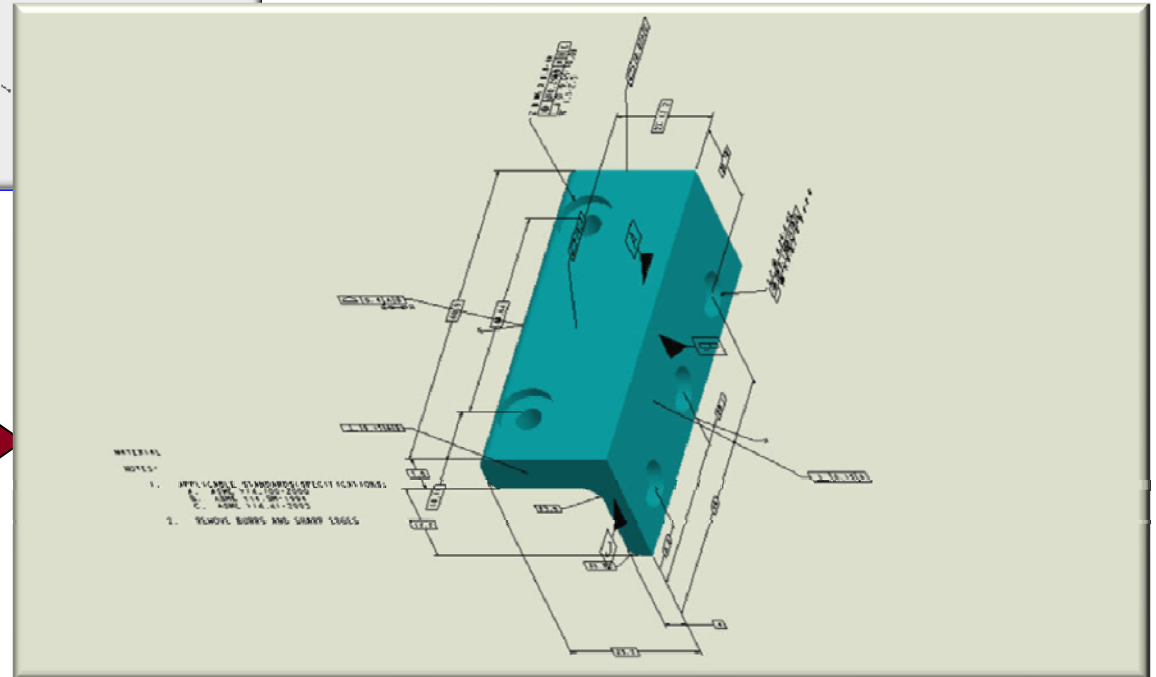**Paul Huang, Army Research Laboratory**

From Drawings

To 3D Models

Source: Jeff Windham RIA

Without the Schema…

With the Schema…

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Model Based Enterprise

MBD
A 3D annotated model and its associated data elements that fully define the product definition in a manner that can be used effectively by all downstream customers in place of a traditional drawing

MBE
A fully integrated and collaborative environment founded on 3D product definition detail and shared across the enterprise; to enable rapid, seamless, and affordable deployment of products from concept to disposal

Proposal → **Concept** → **Design** → **Production** → **Sustainment** → **End Of Life**
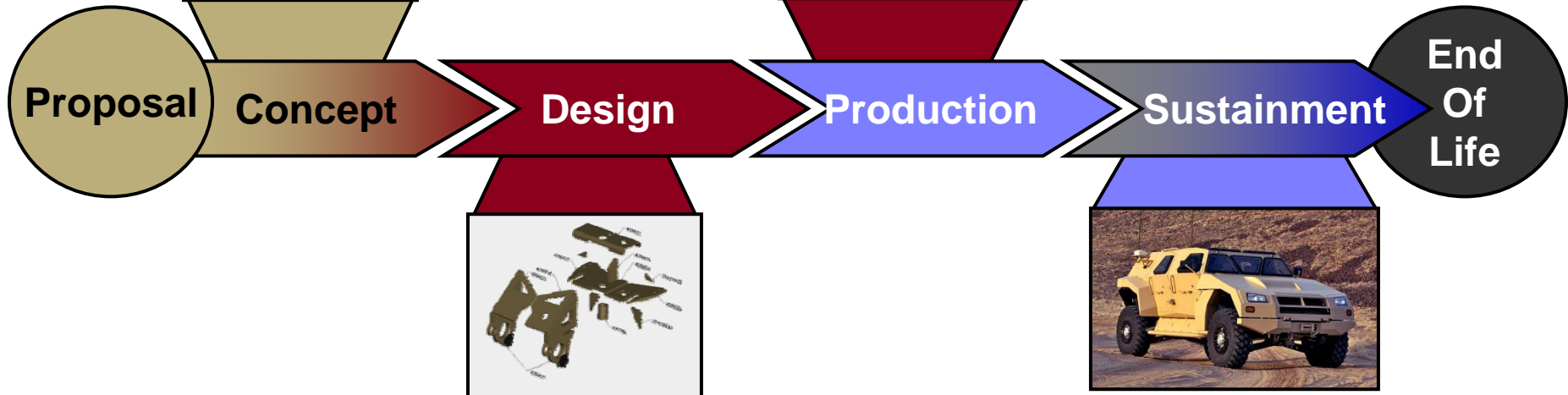
Source: BAE Systems

- **Model Based Definition** (MBD) Product Model is controlling authority
- **All product data is contained in model structure**
- **Maximum data reuse**
- **Direct use of data in downstream applications – substantially reducing lead times**
- **Full product lifecycle support**

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- The <u>product</u> model is a collection of 3D objects, product structure relationships, associated product information, and configuration control information that forms a complete, integrated representation of the product.

- The central concept embodied in *model-based definition* (MBD) is that the 3D product model is vehicle for delivery of all the detailed product information necessary for all aspects of the product life cycle.

- Any number of <u>views</u> of the model can be composed, detailed, and annotated for specific downstream operations including codification & classification, cost analysis, producability analysis, process planning, assembly simulation, procurement, manufacturing, quality assurance, standards compliance, and many others.

Study Reports Reduced Cycle Time using 3D MBD

Reported by an <u>Aberdeen Group</u> study:

- When manufacturers use 3D models, they build only half the number of prototypes

- 3D tools reduce the development cycle by 30-50%

- Standard parts libraries provide significant reduction in component assembly time (design time)

- 3D models reduce non-conformance issues by 30-40%

- 40% of non-conformances are due to 2D drawing inaccuracies and ambiguities

- 85% of companies still use 2D drawings in their operations or with their suppliers

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Advantages of MBD

- **Faster design revisions**
- **Build and test components and assemblies in a virtual environment (do-overs are no problem)**
- **Infinite viewpoints and exploded views of assemblies**
- **Direct to rapid prototyping**
- **Direct to engineering analysis (stress, thermal, interference fit, tolerance stack-up, etc.)**
- **Reduced manufacturing lead time and cost**
- **Automated generation and update of drawings (when drawings are needed)**
- **Generation of technical manuals directly from model data**
- **Costing, materials acquisition, marketing, training…** *everyone benefits!*

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MBD has Advantages but Introduces new Issues

- **MBD issues:**

  - **View of data is dependent on applications used to create data**

  - **Proprietary application file formats limit application choices**

  - **Propriety formats are not optimal for suppliers – they need data formats for low-cost manufacturing applications and viewers**

  - **No accepted standards for digital data storage and long term access**

  - **Products may outlive software applications & computer hardware used to create them**

  - **Current DoD acquisition specifications and guidelines are based on 2D drawings**

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MBD Issues

- **Technical data package requirements**
  - **Delivery of model based data to customer (DoD)**
  - **Specification of 3D data delivery requirements a problem – what data? What format?**
- **Validation of 3D model as product master**
  - **Transition from drawing based release process to digital only, 3D MBD based release process.**
  - **3D model certification.**
- **Supply chain data exchange**
  - **Dissemination of model based data to supply chain.**
  - **Access to model based data by small suppliers.**

- Application vendor lock-in
  - Proprietary data formats inhibit use of best-in-class applications and tools.
  - Open standards not implemented by all vendors.
- Long term access to digital data
  - Product life cycles are increasing dramatically (94 year life for B52 expected).
  - Application revisions cause interpretation errors even in the near term (3-5 year time frame). Difficult to detect.
  - Long term data format standards still in development.

- **Most OEMS moving away from TDPs consisting of combinations of 3D models & drawings to 3D models with complete product manufacturing information (PMI), annotations, and associated data.**

- **Variety of TDP data format options**
  - **Native application formats**
  - **Proprietary interchange formats**
  - **Proprietary viewer formats**
  - **Open standard formats**

- **What is a Technical Data Package (TDP)?**
  - **It is a technical description of an item or product adequate for supporting operation, maintenance, acquisition strategy, design development, manufacturing development, production, engineering, and logistics thru the product's lifecycle.**
  - **The TDP can comprise of a variety of data categories that may include, but is not limited to:**
    - **3D Geometry Models (form)**
    - **Product Manufacturing Information (fit)**
    - **Associated Lists**
    - **Other Product Definition Data**
    - **Quality Assurance Provisions**
    - **Reliability Data**
    - **Maintenance Specifications**
    - **Spares Provisioning Data**

      (form fit and function data sufficient to codify items that need to be stock listed)
    - **Packaging Details**
    - **Performance Requirements (function)**
    - **Applicable Qualifications**
    - **Applicable Certifications to Standards and Specifications**

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Current Practice in DoD

- The current state of practice within DoD is the master data format for mechanical components and assemblies is 2D drawings. 3D models are currently used as reference-only.

- Many weapons systems programs do not acquire an adequate technical data package. Some acquire no data at all.

- Confusion of who owns the "Data Rights"

- *Weapons programs managers currently have insufficient guidance documents to use to specify what 3D model data and product data should be delivered and in what format.*

- *PM/PEO*

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Current Practice in DoD

- Weapons systems Program Managers must determine the level of technical data to be delivered with the system.
- Within DoD, Technical Data Packages are specified by MIL-STD-31000 and associated Data Item Descriptions (DIDs).
- Several DoD organizations have developed ad hoc definitions of 3D TDPs in order to deploy MBD data for procurement of replacement components.
- The consequence of maintaining the current practice is that DoD organizations and PMs will continue to develop their own unique specifications for 3D TDPs.
  - This will impose costs on vendors who must respond to inconsistent TDP requirements and data format requirements.
  - Procurement officials will have to define the 3D TDP requirements for each program.
  - Archiving of 3D TDPs will be difficult because of the variety of content.

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What Data Should DoD Program Managers Purchase?

- **Data is critical in all phases of the product lifecycle <u>and</u> to all organizations responsible for providing support**
  - **Operate, train, maintain, repair**
  - **Spares provisioning**
  - **In-house overhaul**
  - **Produce replacement parts**
  - **Upgrade and refit (including re-design)**
  - **Manufacturing process and tooling data**

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Revised TDP Specifications and Policies Needed for MBD Data Acquisition

- **Technical data package (TDP) requirements for Model Based Definitions (MBD) need to clearly specified (MIL-STD-31000 revision in progress)**

- **Minimum data set guidelines**

- **Well defined TDP levels (needs further revision MIL-STD-31000)**

- **Data format guidelines**

Revised TDP Specifications and Policies Will Have Significant Pay Back

- **Lower Cost**
  - **A DLA survey showed that if a modern tech data package was provided to the supplier, it would help reduce the procurement cost of a part by almost 27%**
  - **The survey noted that suppliers would be able to reduce the cost of quoting, which accounts for 8% of the bid**
- **Faster Delivery**
  - **The DLA survey indicated that almost 19% of supplier scrap and re-work was due to poor TDP quality**
  - **3D TDP will help streamline the creation of process plans and decrease the chances for manufacturing errors**
  - **Suppliers will be able to use model data to rapidly create instructions for production operations and inspection**

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TDP Project Objectives

- **Transform technical data package requirements from a system based on 2D drawings to a system based on 3D model based product definition.**

- **Develop recommendations for DoD TDP policy, standard(s) and guidelines**

- **Develop TDP standard(s) and/or guidelines that DoD services can use to determine the optimum data levels and data formats for system acquisitions**

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TDP Project Approach

- **Team formation**
- **Background review**
  - **Review relevant standards, specifications, guidance documents, and policy statements**
- **Requirements analysis**
  - **Services**
  - **Supporting agencies**
  - **Project Managers**
  - **Primes**
- **Develop recommendations report**
- **Revise target specifications**

TDP Project Team

Government

Army: ARL, ARDEC – Picatinny Arsenal, RIA

LOGSA

NIST

NAVSEA – NSWCCD, NAVAIR

Air Force Research Laboratory, Warner Robins AFB

DLA- DLIS

Marines Corps

USCG

NASA

Industry

Primes: Boeing, Lockheed Martin, GDLS, BAE, PTC and others

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- **The team has launched a MBE Website**

- **It is intended to act as an information source for the supply chain**
  - **It contains the assessment results are distributed via this site**
  - **Provides a information database for MBE**
  - **A Place to communicate to with the supply chain**

www.model-based-enterprise.org

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Questions?

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