



U.S. Army Research, Development and Engineering Command



***TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.***

Reuse of Model Based Definition Data to Increase  
Army Efficiency and Reduce Lifecycle Costs

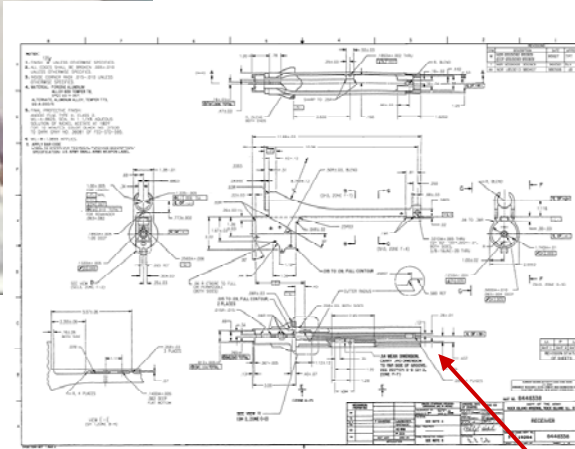
Paul Huang  
Army Research Laboratory  
MBE Program Leader



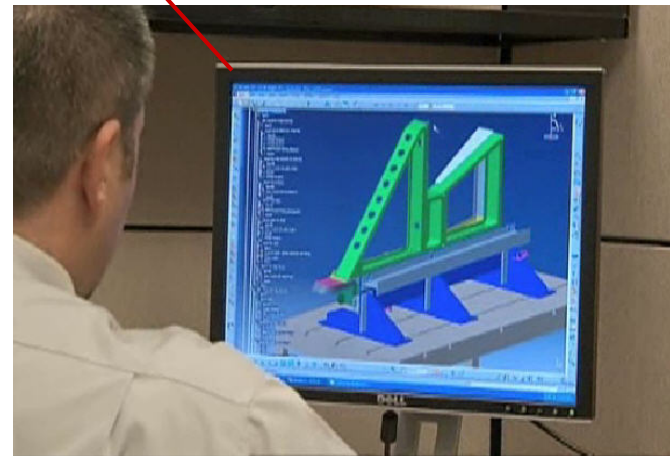
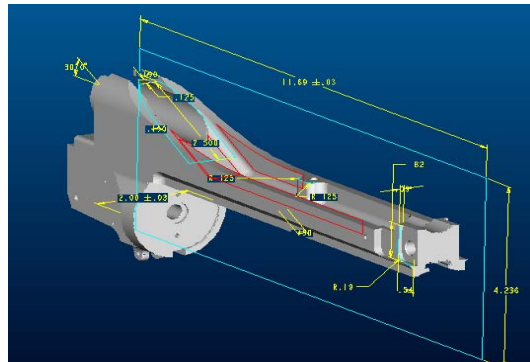
- **Define Model Based Enterprise (MBE)**
- **Obtain High Level Management Understanding and Support for implementing MBE activities in DoD.**
- **Explain how MBE contributes value throughout the weapon system life cycle**
  - **Design and production**
  - **Field operations (Training, Tech Pubs and manuals)**
  - **Depot Operations**
  - **Supply Chain Activities**
- **Discussion – Questions and Answers**



# What are Models ?



**Today Drawings come from models**



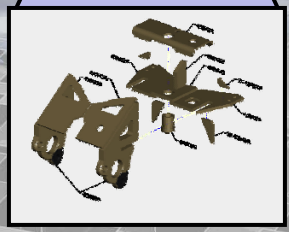
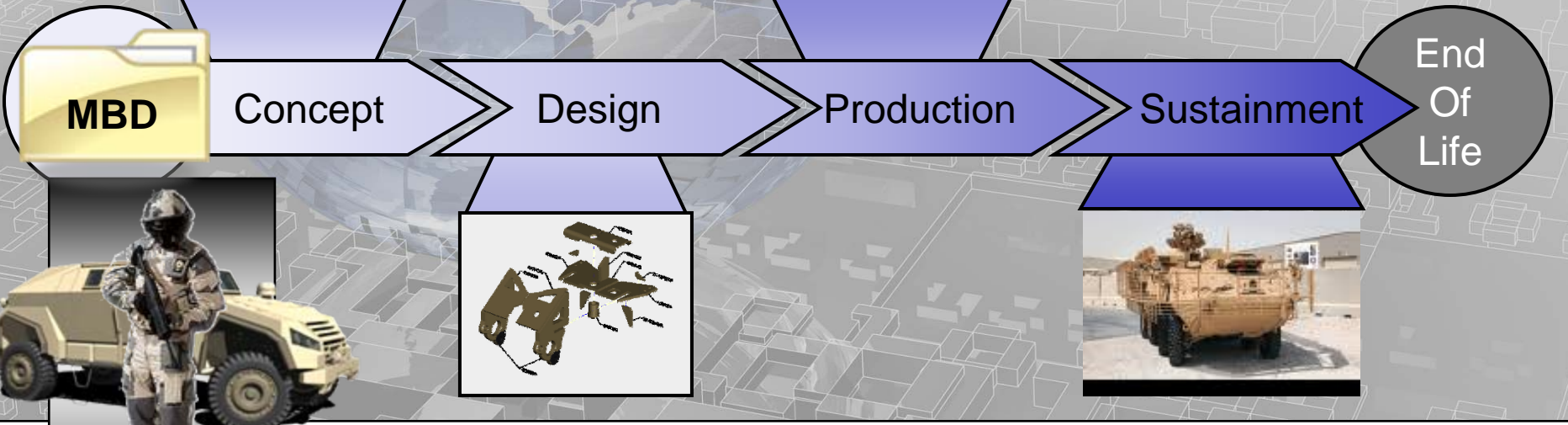
**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**



# What is MBE?

The Model Based Definition (MBD) is created at the beginning of the lifecycle then reused throughout the enterprise, thus creating the Model Based Enterprise (MBE)

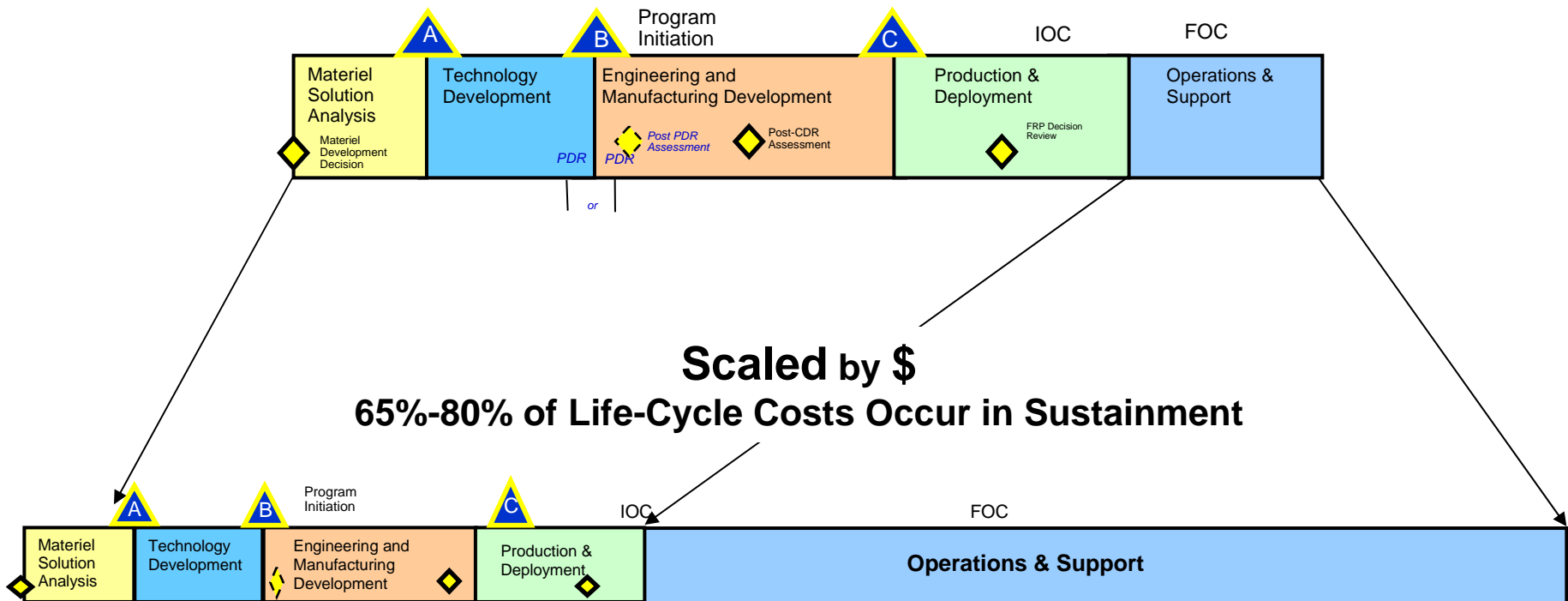
MBE is an integrated and collaborative environment, founded on 3D product definition (MBD) shared across the enterprise, enabling rapid, seamless, and affordable deployment of products from concept to disposal.

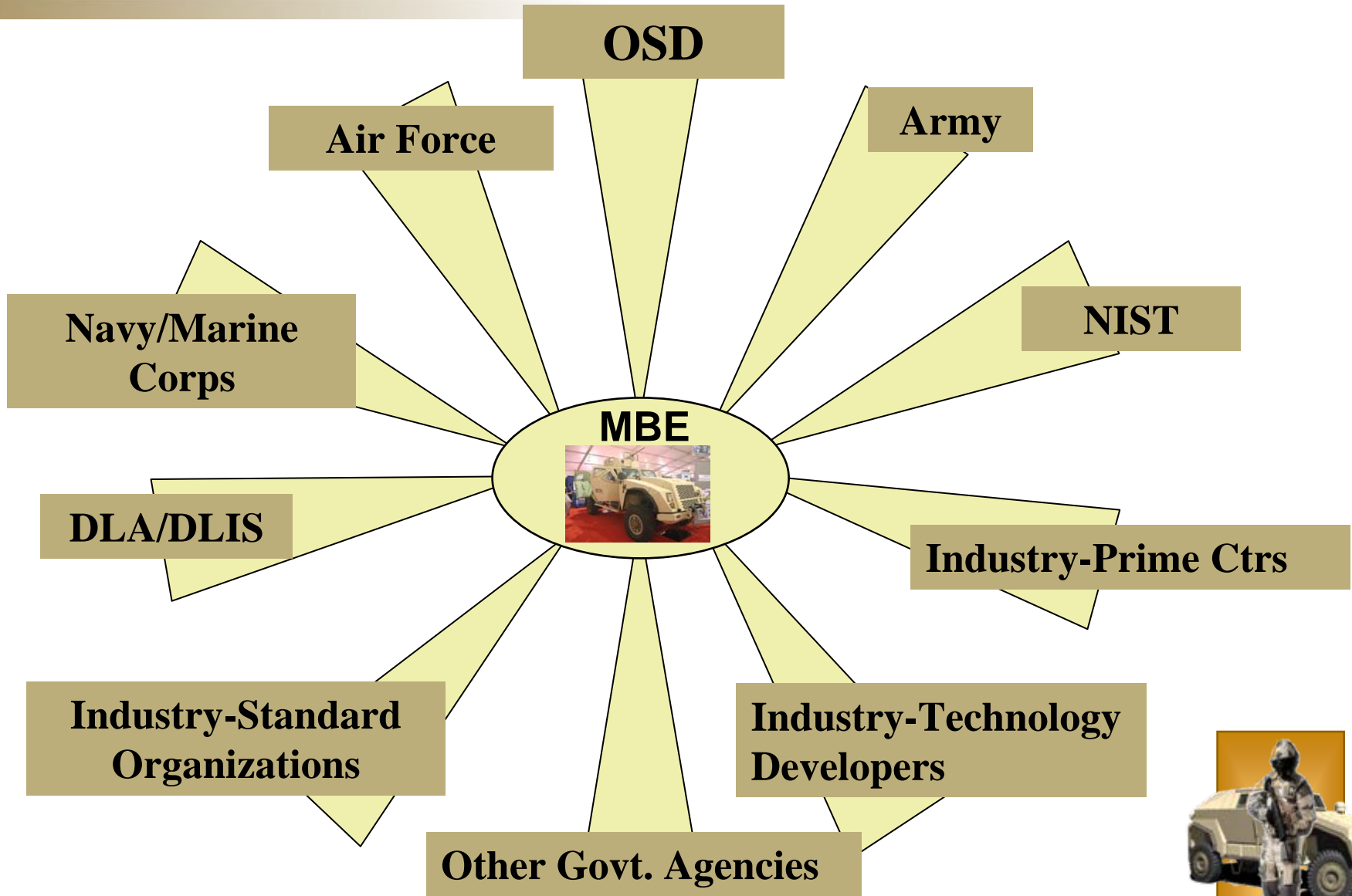




# MBE Payoff

MBE will help DoD to field, maintain, and upgrade weapons system more rapidly and economically over the lifecycle



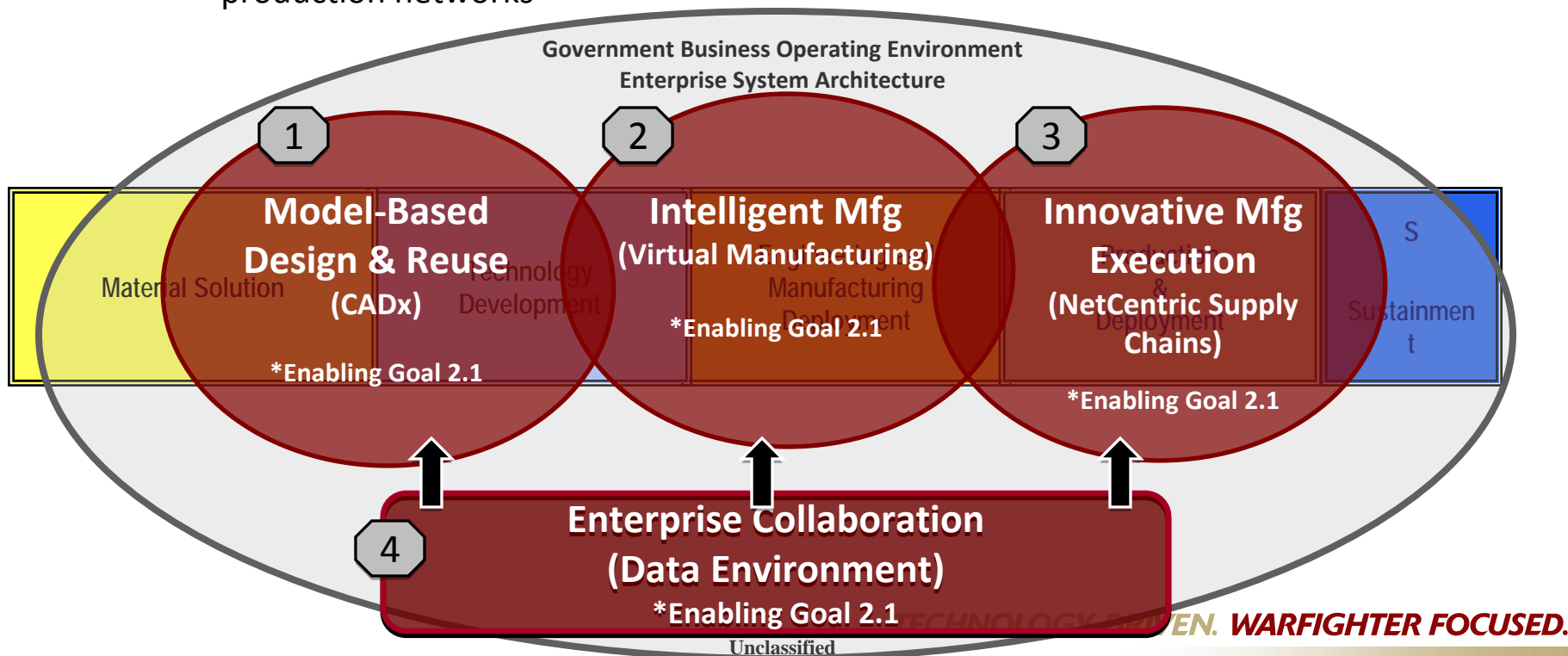




# Where is MBE Needed?

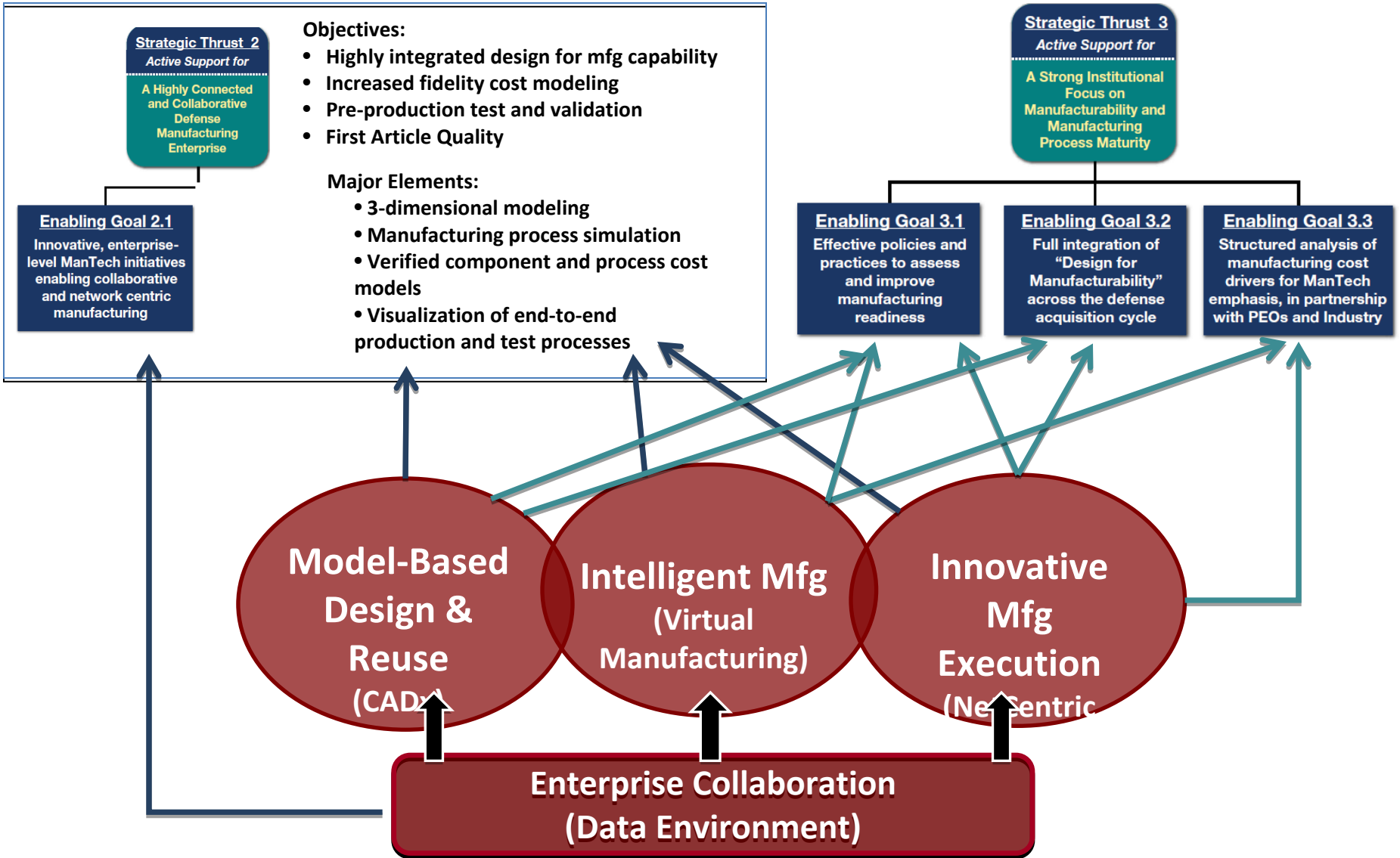
MBE is needed across all of the Acquisition, Technology, and Logistics Lifecycle areas:

1. **Model-Based Design & Reuse** – Design optimization through integrated applications and CAD interoperability
2. **Intelligent Mfg** – Reduce manufacturing risk and cost through modeling and simulation methodologies
3. **Innovative Mfg Execution** – Network Centric mfg and single digital master files
4. **Enterprise Collaboration** – Seamless collaboration across design and production networks





# MBE Links to DOD ManTech Strategic Plan

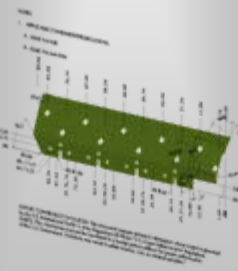
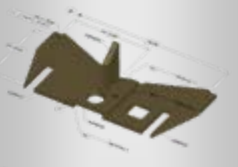






## State of the Industry

- 3D Models drive all CAD. 2D data is a derivative of the models
- PLM database associates Models with Metadata in a logical structure
- Models becoming the Master



## Future State of Practice in Industry and Army - DOD

- Fully Annotated 3D Model are the Master
- Reuse models for production activities such as machining, line layout, work instructions
- Fully defined 3D TDP
- Certification of MBD data and the Product Master

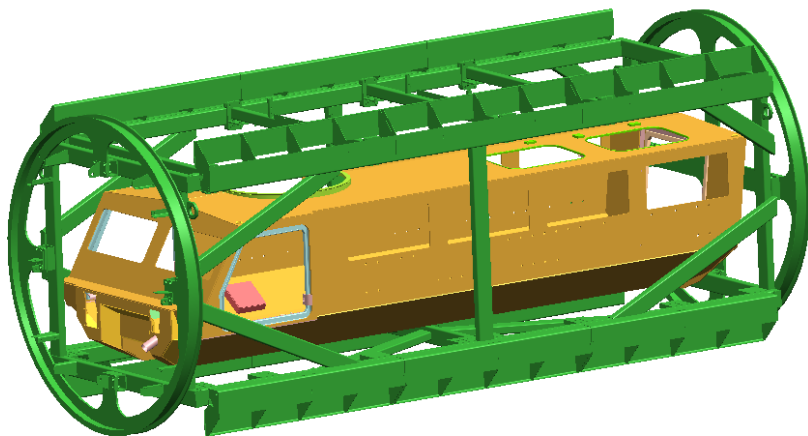
Increasing capability rapidly  
being introduced by major  
CAD Vendors



### MRAP Egress Trainer

- MRAP's may roll over when hit with blast from mines or IEDs
- Trainers used to drill soldiers how to rapidly escape a roll over

- ME2100 (Structure)
- ME2000 (SideCoors)
- ME2000 (Inners)
- ME2000 (SeatBars)
- ME2000 (LumbarRys)
- ME2000 (SideCockAssist)
- ME2000 (CrewSeats)
- ME2000 (InStowage)
- ME2000 (SquadSeats)
- ME1100 (MissionEquipment)
- ME1100 (Intercom)
- ME1200 (InLighting)
- ME1300 (PowerDist)
- ME1400 (CrewInstruments)
- ME1500 (FuelUp)
- ME1600 (Windows)
- ME1700 (HVAC)
- ME1800 (PassengerHeater)
- ME1900 (Pneumatic)
- ME2000 (WeaponStation)
- ME2100 (Brake)
- Applications



**MRAP Plus Egress Trainer**  
**Design Start to Release 19 Days**



**No Drawings/only Models which are all fully annotated.**

- Design hours bid: without MBE 26,000 hrs: with MBE by MBE Team 1,500 hrs Actual: 968 hrs
  - Saving-25,000 hrs Enabled by reuse of MBE data.
- Design Start: 9/18 Finish/Model Release: 10/1/09 **9 Working Days**
- Manufacturing Bill of Materials (MBOM) Start: 10/2 Finish/Release: 10/7/09
- Production Support for Design: Budgeted 720 hrs Act 0 hrs
- Required Wt Structure: 9,500 lbs Actual 9,440 lbs



## State of the Industry

Illustrations are Recreated Based on Old Design Data or line drawings

- Tech Manuals are 2D Based With Limited 3D Content
- Tech Manuals are a Serial Process Started Late in the Project Lifecycle often later than the vehicle is fielded



## Future State of Practice in Army

- Reuse MBE data for audio visual instructions (AVIs) in technical pubs and manuals
  - Operator manuals
  - Level 1 Maintenance Manuals
  - Depot Maintenance Work Req
- Today Soldiers learn quicker using visual instructions instead of text
- Configuration Management of data to insure correct version is available
- 3D Interactive manuals (respond to queries)

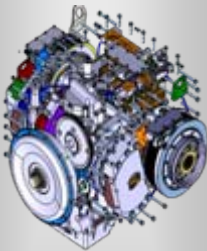
Opportunity to dramatically improve effectiveness of Pubs



### Stryker Maintenance Training System (MTS) Device

- 3D data used to create immersive training environment
- The MTS is a family of computer-based training devices that interactively simulate and demonstrate performance of scheduled and unscheduled maintenance and repair actions in a virtual-reality environment. MTS classroom training is presented in 3D interactive format identical to that obtainable from net-centric MBE data.
- Stryker Maintenance Trainers estimate a **savings of 25% in maintenance and repair time in the field.**
- ROI - Estimate yearly maintenance and repair time for a single vehicle approximately 1,000 hours. Applying an average labor cost of \$100 / hr to an estimated number of vehicles in service of 1000, yields an **estimated yearly ROI for reuse of Net-Centric MBE Data as interactive 3D models imbedded within animated instruction files is \$25M.**





## Current State of Depot Practice

- Typically the Depots receive only limited 2D TDPs at best. Many times nothing.
- Work instructions are paper based with pictures of disassembled hardware
- **There is typically no PLM and limited ERP**
- No manufacturing simulations

## Future State of Depot Practice

- Digital Depot activities are currently being piloted at:
  - RRAD, LEAD
- Working with technology providers to perfect Ltwt PDF work Instructions
- Depots will receive 3D data
- Visual based work instructions on the shop floor
- Simulation based shop floor planning for streamlining new mission requirements
- **Integration of data from PLM, ERP, and MES**

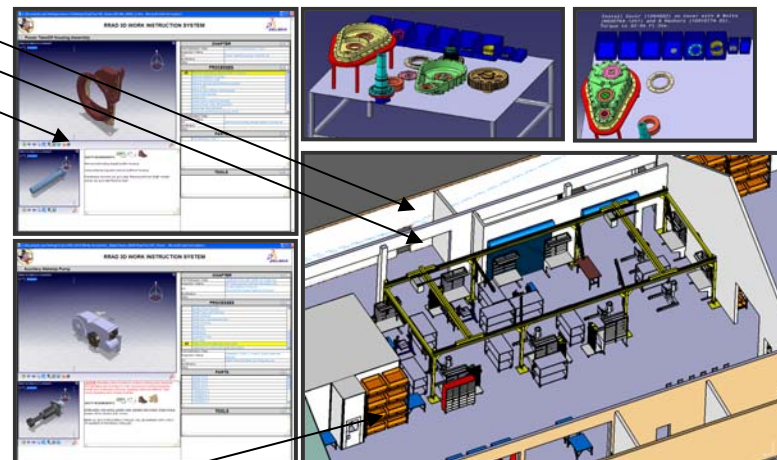
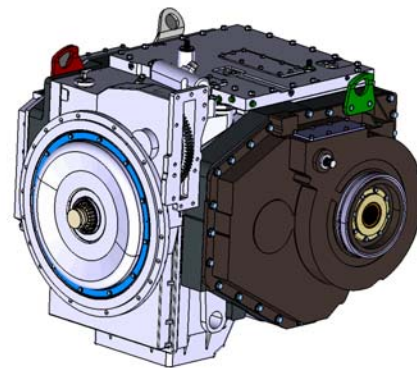
Depots Are One Of The Largest Potential Users Of MBE Data

# Benefits for all Depots

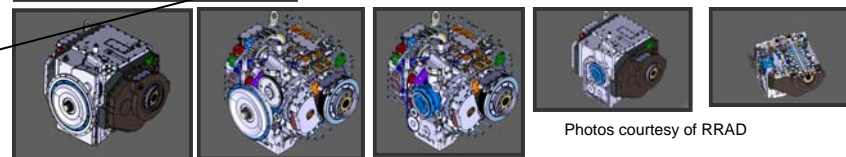


## Bradley Cross Drive Transmission

- **Prior to initial production start**
  - Process plans without first article
  - Optimize layout
  - Optimize factory flow
  - Create work instructions
- **Simulate in pixels rather than in brick and mortar**
- **Complete multiple simulation scenarios in order to determine best possible processes**



Bradley Cross Drive Transmission Work Cell

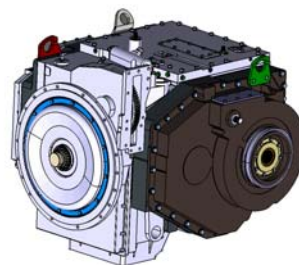


Photos courtesy of RRAD



## AT RRAD

- Two teams trained and functioning
  - Methods and Standards
    - BFV Transmission Flow
    - Caterpillar engine rebuild
  - Production Documentation
    - BFV Transmission Work Instructions
      - On shop floor now
      - L3 Com wants the work instructions
    - BFV 25mm Gun rebuild
    - BFV Turret Servo Drives rebuild



**RRAD 3D WORK INSTRUCTION SYSTEM**

**Auxiliary MakeUp Pump**

Select an object or a command

Product1

**SAFETY REQUIREMENTS:**

Install remaining housing using care to align dowel pins. Install screws and washers. Torque all screws to 100 to 120 lb-in (11 to 14 Nm). Verify that each shaft has some end play.

**TORQUE:** Screws 100 to 120 lb in (11 to 14 Nm)

**NOTE:** ALL BOLTS REQUIRING TORQUE, WILL BE MARKED WITH A FELT-TIP MARKER AFTER BEING TORQUED.

**CHAPTER**

Part Distribution Table	T:\200500 AUXIL.MAKE UP PUMP-04c
Inspection Criteria	XP 0004 General Overhaul Information.doc
AVI	Auxiliary MakeUp Pump.avi
Modification	Disassembly-Auxiliary MakeUp Pump.avi
Other	

**PROCESSES**

Install Pump Element
Install Plugs and Packings
Install Gerators
Install Keys and retaining ring
Install Housing
Install Key
Install Seal
Install Ring
Assemble Valve
Test Valve
Install Valve into Make-Up Pump Assy
Install Test to check work instruction output

**Part Distribution Table**

Inspection Criteria	
AVI	Install Housing.avi
Modification	
Other	

**PARTS**

AN950-415.7
AN950-415.8
AN950-415.9
AN950-415.11
AN950-415.12
AN950-415.13
AN950-415.14
AN950-415.15

**TOOLS**





**This program will prove the value of interactive visual based documents and provide an affordable solution that is ready for adoption by the Army resulting in:**

- 30% Reduction in time to layout or rebuild line, work stations, and assignment of tasks and tools
- 25% Increase in more rebuilt vehicles in the first 3 months of operation
- 30% Reduction in operator training time
- 50% Improvement in clarity of Work Instructions
- 20% Reduction in rebuild costs for vehicles during first 3 months of operation



# Questions?

