BAE SYSTEMS

MBE
Model Based Environment

The Next Generation of Business

Delivering a Product Definition in a Model Based Environment

Delivery of Product Data in a Model Based Environment

By Roy Whittenburg, Project Manger II

Agenda

- Introductions
  - Brief Introductions, Personal & Corporate
- MBE an Overview
  - Overview of the Model Based Environment
- Delivering the TDP?
  - How Do You Distribute a MBD
- The BAE Experience
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- Closing
  - Wrapping It All Up

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MBE
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The Next Generation of Business

Introductions

Brief Introductions, Personal & Corporate









Who I Am

- Roy Whittenburg
  BAE Systems
  - Project Manager II
  - Currently responsible for MBE implementation and Modeling Process within Advanced Manufacturing Engineering at Ground Systems, York.

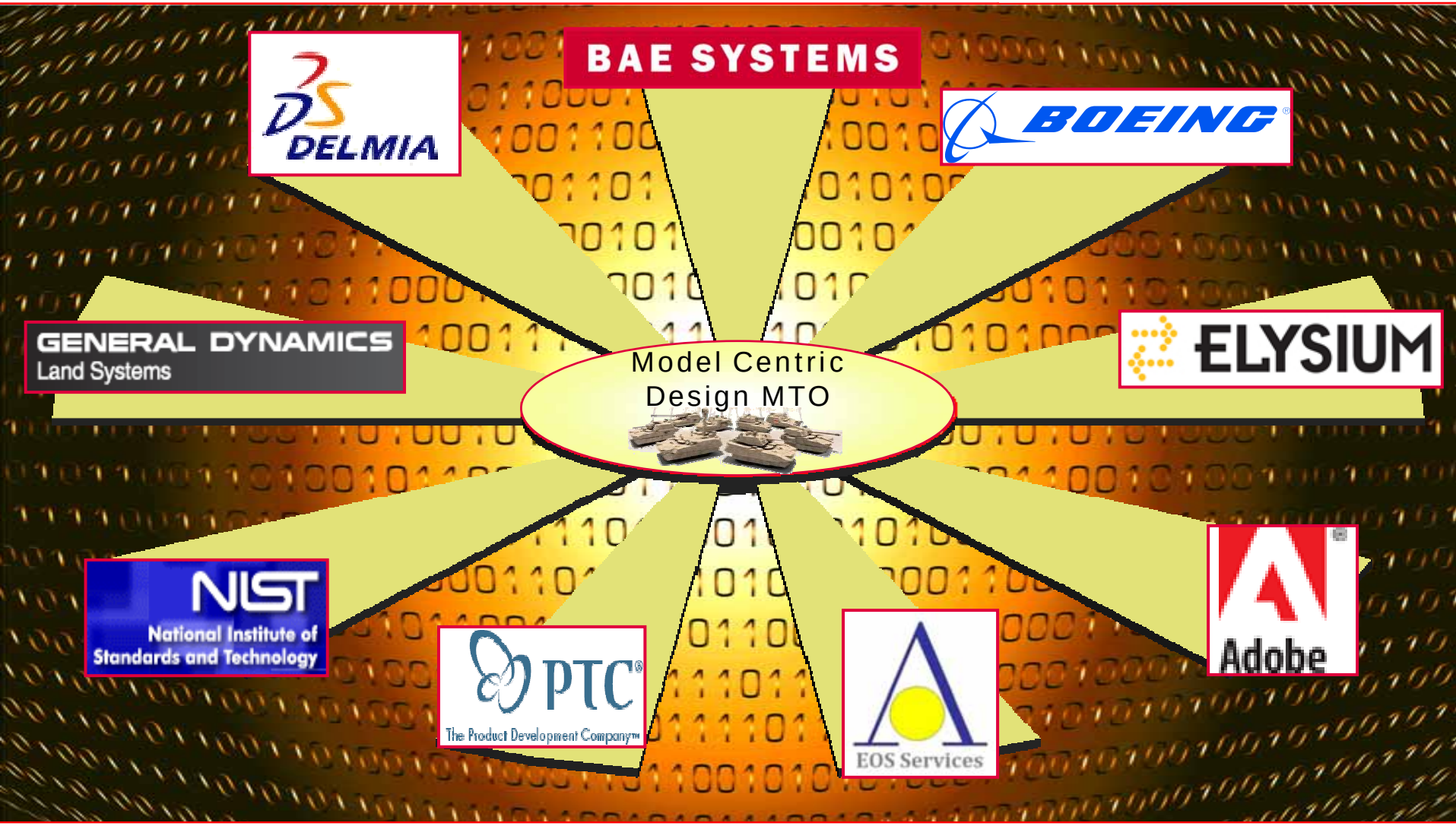
BAE Systems Land & Armaments

Ground Systems – A Summary

- Protected Fighting Platforms for Today's Warfighter as well as the Battlefield of Tomorrow
  - Predominant Supplier to the U.S. Army Heavy Brigades with Bradley, HERCULES, Paladin, M113
  - Mine-Protected Wheeled Vehicles
  - FCS Manned Ground Vehicles and Armed Robotic Vehicle
- Key Technologies
  - Advanced Protection and Mobility Solutions for Soldiers, Manned Vehicles and Robots
  - Outstanding Program Management and Experienced Workforce
  - 3,094 employees, including 600+ technologists (+522 contractors)
- World-Class Development Processes
  - CMMI Level 5 Software and Systems Engineering Process
  - Physics-Based Models & Real-Time Simulation Capabilities
  - Rapid Prototyping of Complex Systems
- Lean, Cost-effective Production Facilities

GS is a modern, efficient, full-spectrum developer, integrator and supplier of survivable, lethal ground combat platforms and advanced technologies

2008 Army Research Laboratory Sponsored Team



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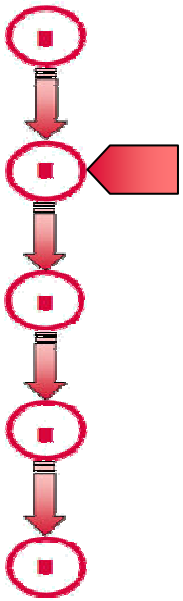

MBE an Overview

Overview of the Model Based Environment

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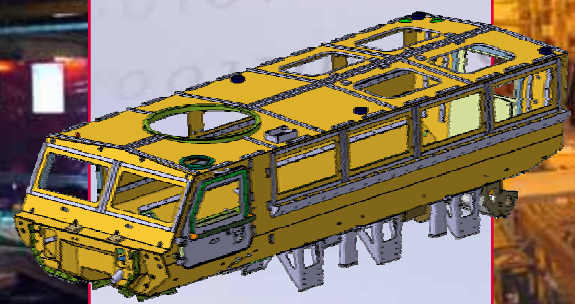
What Is Model Based Environment?

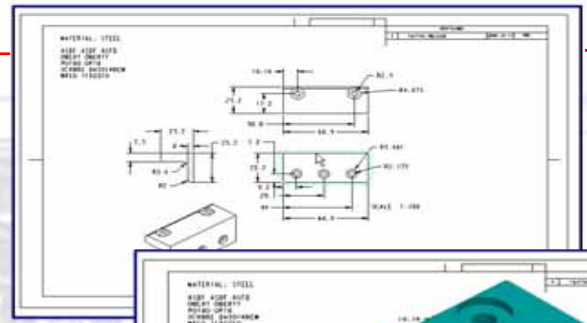
A fully integrated and collaborative environment founded on 3D product definition detail that is shared across the enterprise to enable rapid, seamless, and affordable deployment of products from concept to disposal.



The Journey

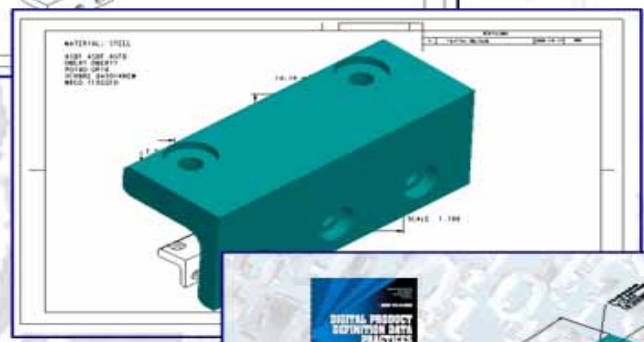
Drawing Based

Master 2D Drawing



Model Centric

3D CAD Model with Master 2D Drawing



Model Based Definition

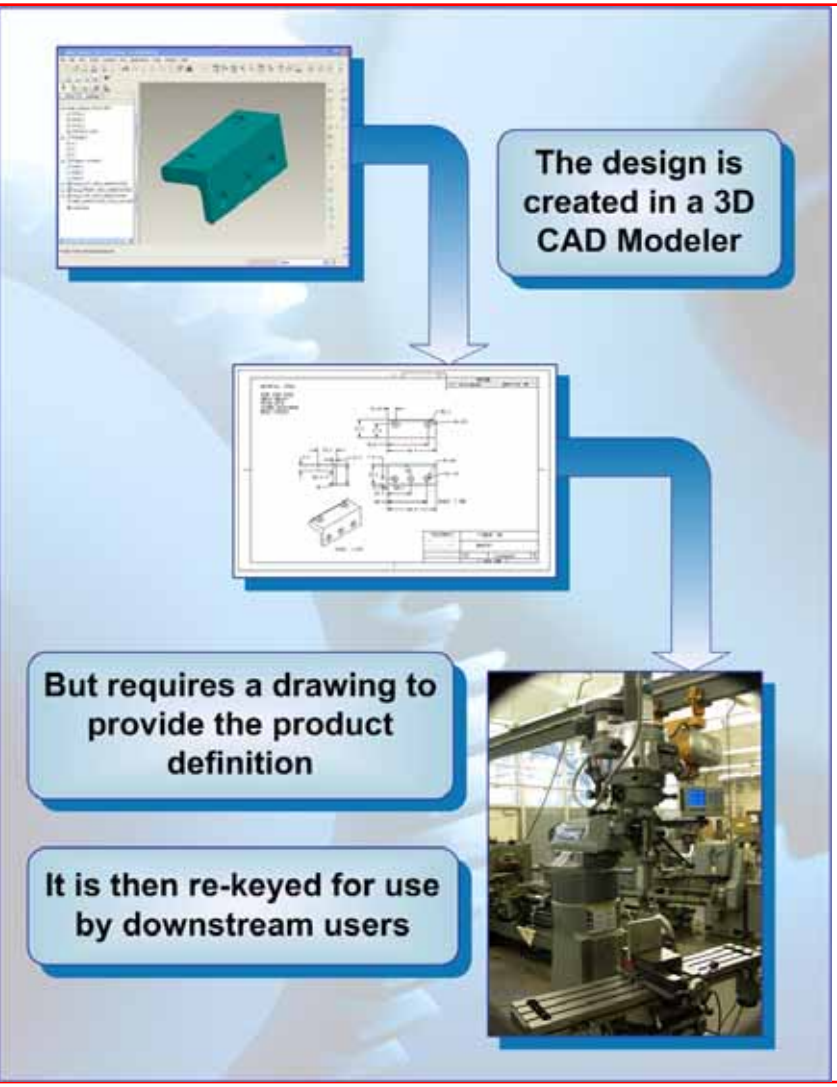
Master 3D CAD Model with 3D Annotated Models, 2D Drawings by exception

Model Based Environment

Master 3D CAD Model with 3D Annotated Models fully leveraged by the Enterprise

This is a natural evolution of the design & production process

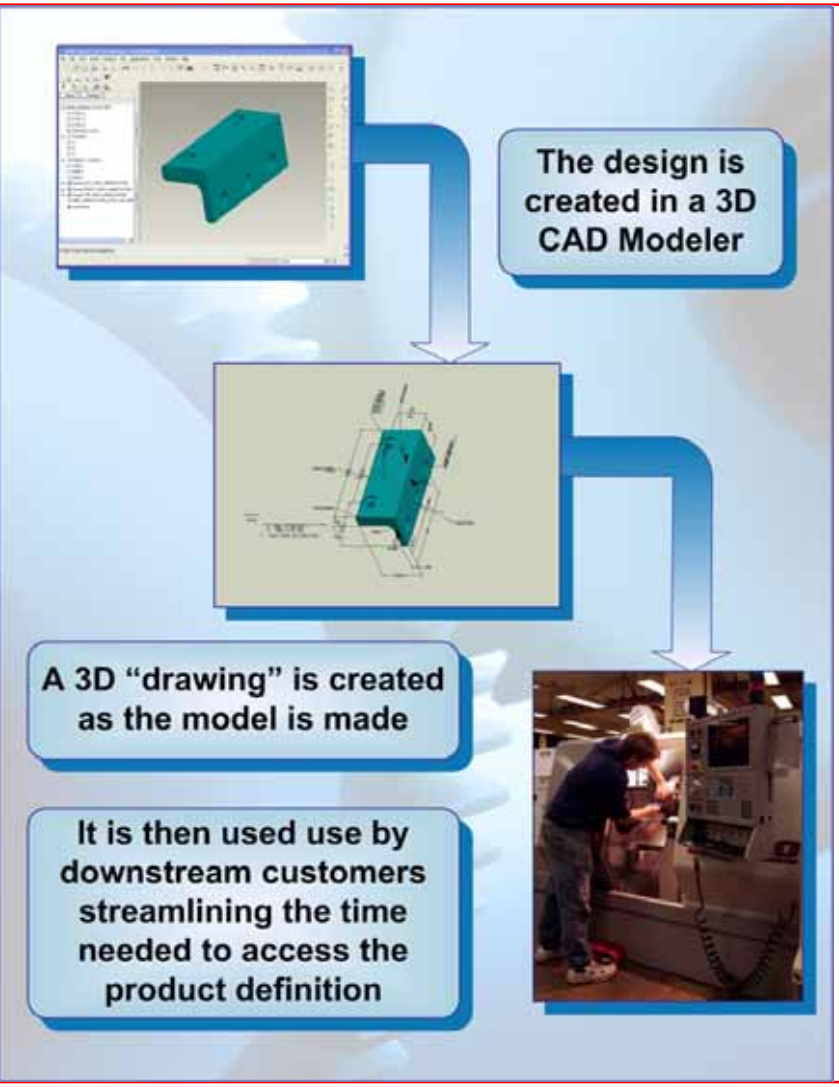
Conventional Design to Manufacturing Process



- The conventional processes are inefficient
- They rely on the manual re-keying or re-creation of the product definition
- Delivery of the product definition is also paper base
- In process changes that may or may not get incorporated into the model results in confusion and a high error rate

The conventional process has reached its functional limits

The Model Based Definition Process



- The MBE approach streamlines the process by eliminating the traditional 2D Drawing
- It also incorporates the needed downstream interfaces so the product definition can be reused vs. re-created
- This approach also allows for a single source master reducing confusion and errors

MBE is key to our future ability to reduce our time to market and lean our processes

Taming the Furball – Process For Annotating Models Vs. Drawings

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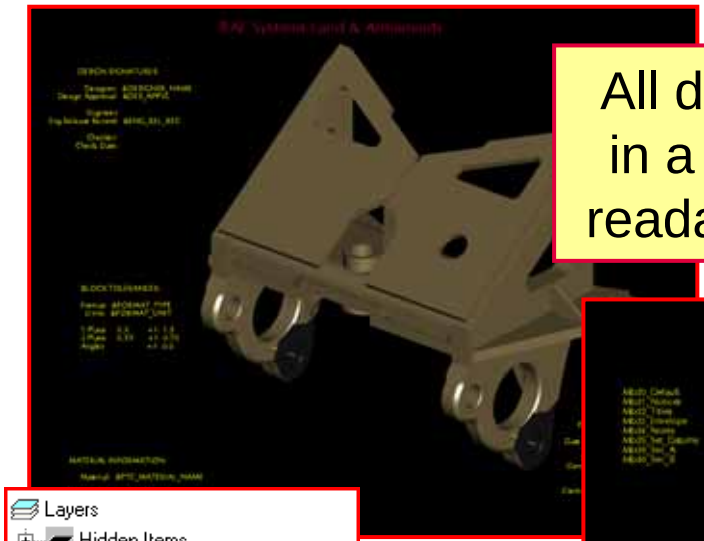
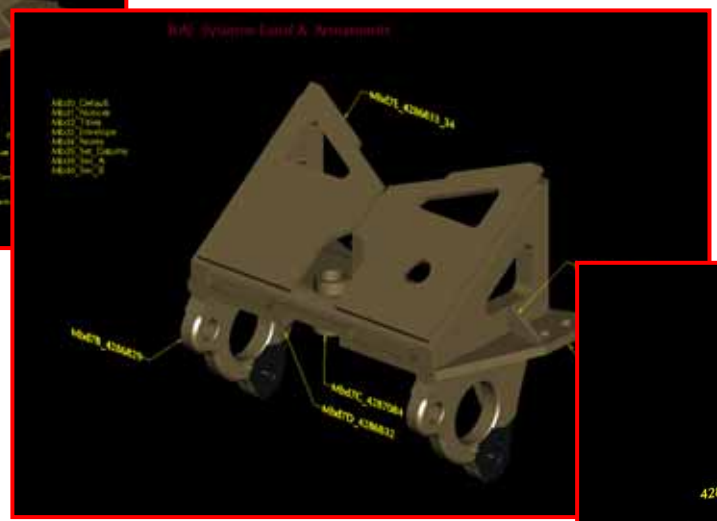
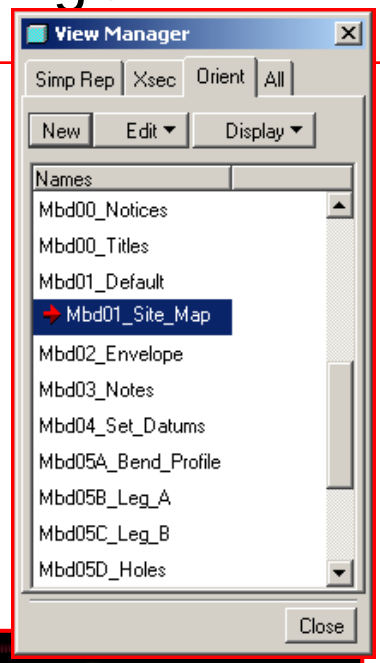
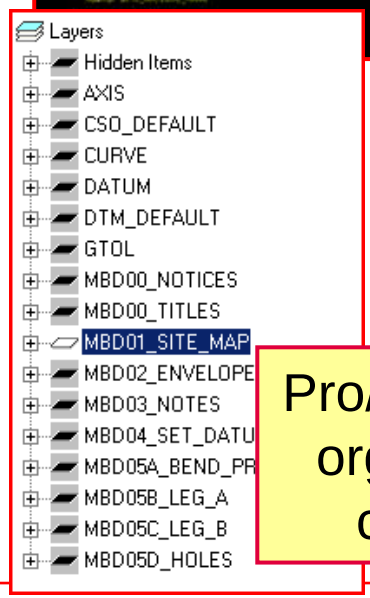


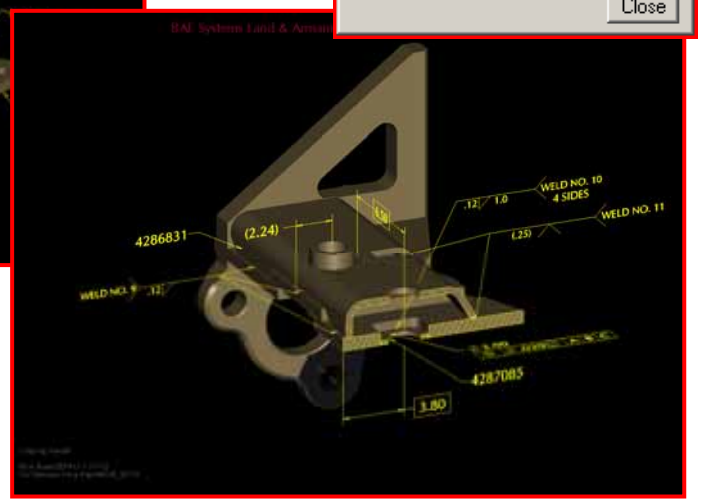
All data that is normally contained in a drawing is now available in a readable format in the Pro/E Model





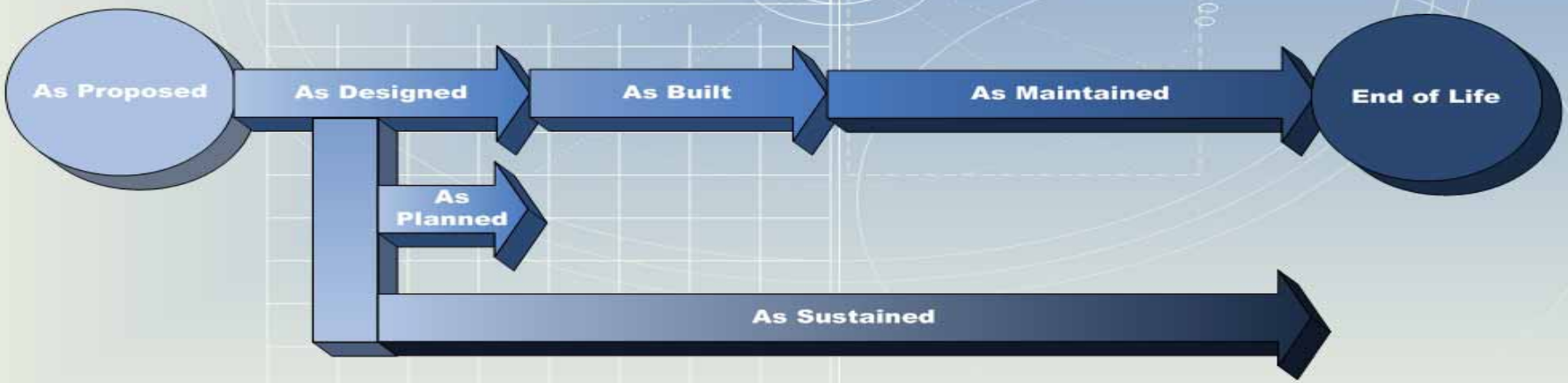


Pro/E Wildfire provides increased organizational abilities through combined views and layers



The Big Models in MBE

- The product life cycle can be broken down into a series of architectural “models” with unique applications
  - These are the upper level models that must be controlled in order for MBE to work



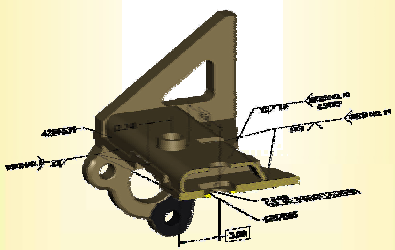
Base Application Architecture

The MBE Collaborative Environment is made up of three base environments as shown below:

Model Based Environment Prototype

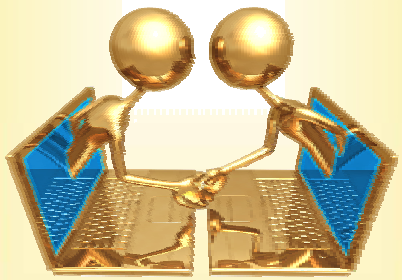
Design Environment

- Pro/Engineer Wildfire 4



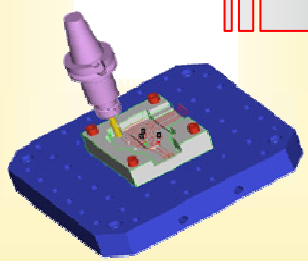
Collaboration Environment

- Windchill PDMLink 9.0
- ProjectLINK 9.0
- ProductVIEW 9.1



Manufacturing Environment

- Delmia
- PPR Hub
- Manufacturing Execution Systems



Note:

Each company will use its own Manufacturing Environment and the applications that mach their processes

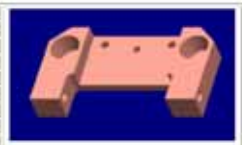
Digital Product Definition Package (DP)2

EPDM Report Document Containing Links to Data and Overall Component Revision

Digital Product Definition Package

Component Information

Part Number:	61C01371
Nomenclature:	Mount, Lower Gate, RSV
Contract:	DAAE30-95-C-0009
Author:	D. LUTZ
Maturity Index:	6
Revision:	-
Status:	Released
Superceded:	False
Draft:	1
Date Revised:	8/4/04



Component Definition Items

Item	Type	Draft	Superceded
61C01371_MOUNT_LOWER_GATE.prt	Pro/E Part	4	False
61C01371_MOUNT_LOWER_GATE_NT.xml	Gen. Notes	6	False
61C01371_MOUNT_LOWER_GATE_PL.xml	Parts List	2	False
61C01371_MOUNT_LOWER_GATE.stp	STEP	4	False
61C01371_MOUNT_LOWER_GATE.edz	Productview	4	False
61C01371_MOUNT_LOWER_GATE_REV.xml	Rev. History	6	False

Related Data Items

Item	Type	Revision
MIL-STD-100	Military Standard	F
MIL-STD-130	Military Standard	C
ASME Y14.41	Industry Standard	A
THREADS ARE ASME B1.13-1995	Industry Standard	1995
AMS 4027	Material Specification	-
AMS 2471	Finish Specification	-

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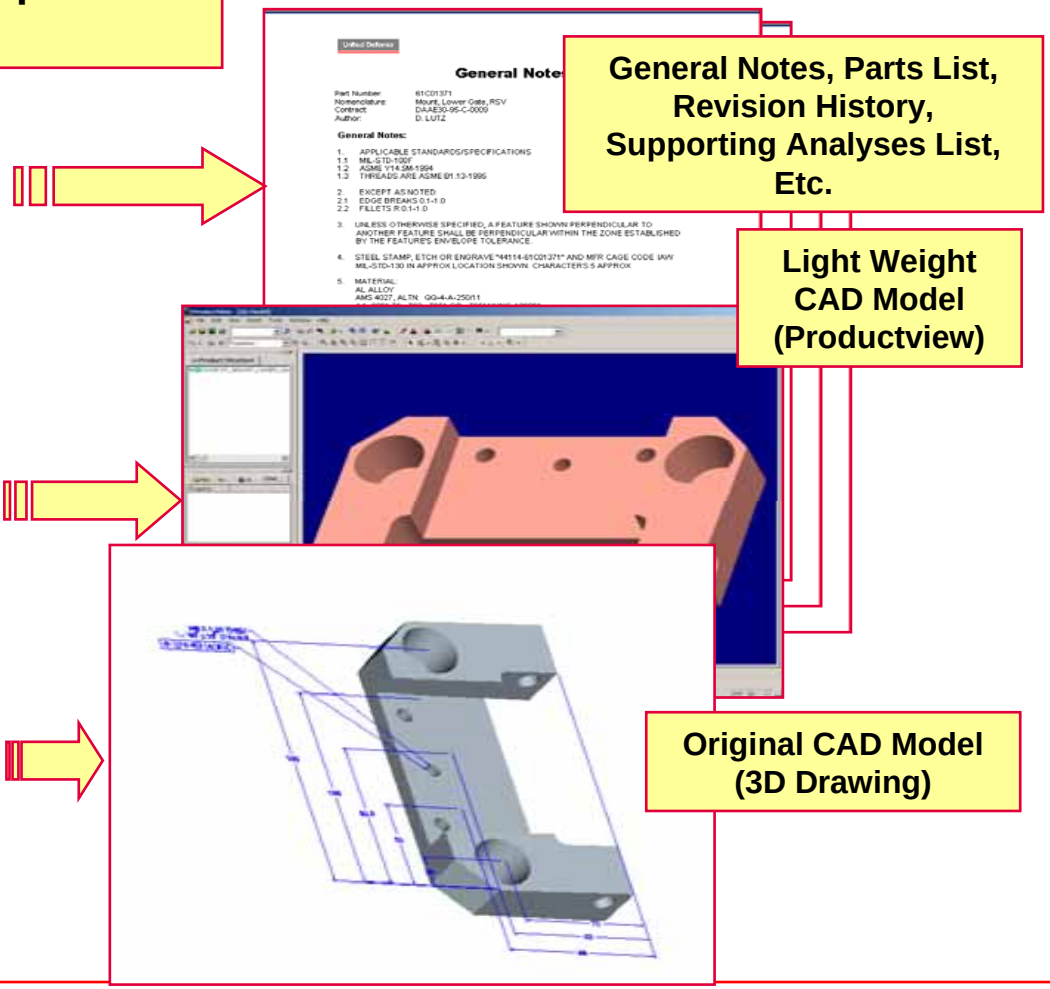

Proven Benefits

Significant Reductions:

- Non- Recurring Cost reduced By: 50%
- Non-Recurring Cycle Time Reduced By: 50%
- First Article Costs Reduced By: 65%
- TDP Changes Reduced By: 50%
- Product Non-Conformance Reduced By: 90%
- Recurring Cycle Time Reduced By: 50%
- Recurring Costs Reduced By: 50%
- Support Cost Reduced By: 50%

Other Benefits:

- Reduced Learning Curve
- Integrated Learning
- Validated Design & Assembly Integrity
- Validated Operations Sequences & Tooling
- No Traditional Drawings
- Flexibility of Work Force
- Drives & Validates Design Release

This data was initially published by Boeing but has since been validated through real world use at BAE Systems Land and Armaments

EVERETT, Wash. (AP)--A powerful computer system that simulates the assembly of Boeing Co.'s new 787 Dreamliner **cut typical costs by about 20 percent and trimmed a full year** from production, officials said Wednesday.

Reduces Product Cost By:

- Defining and Validating Factory Processes
- Defining and Validating Assembly Processes
- Defining and Validating Quality Process
- Defining and Validating Tolerance Management

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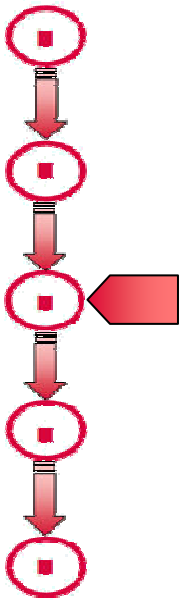


Delivering the TDP?

How Do You Distribute a MBD

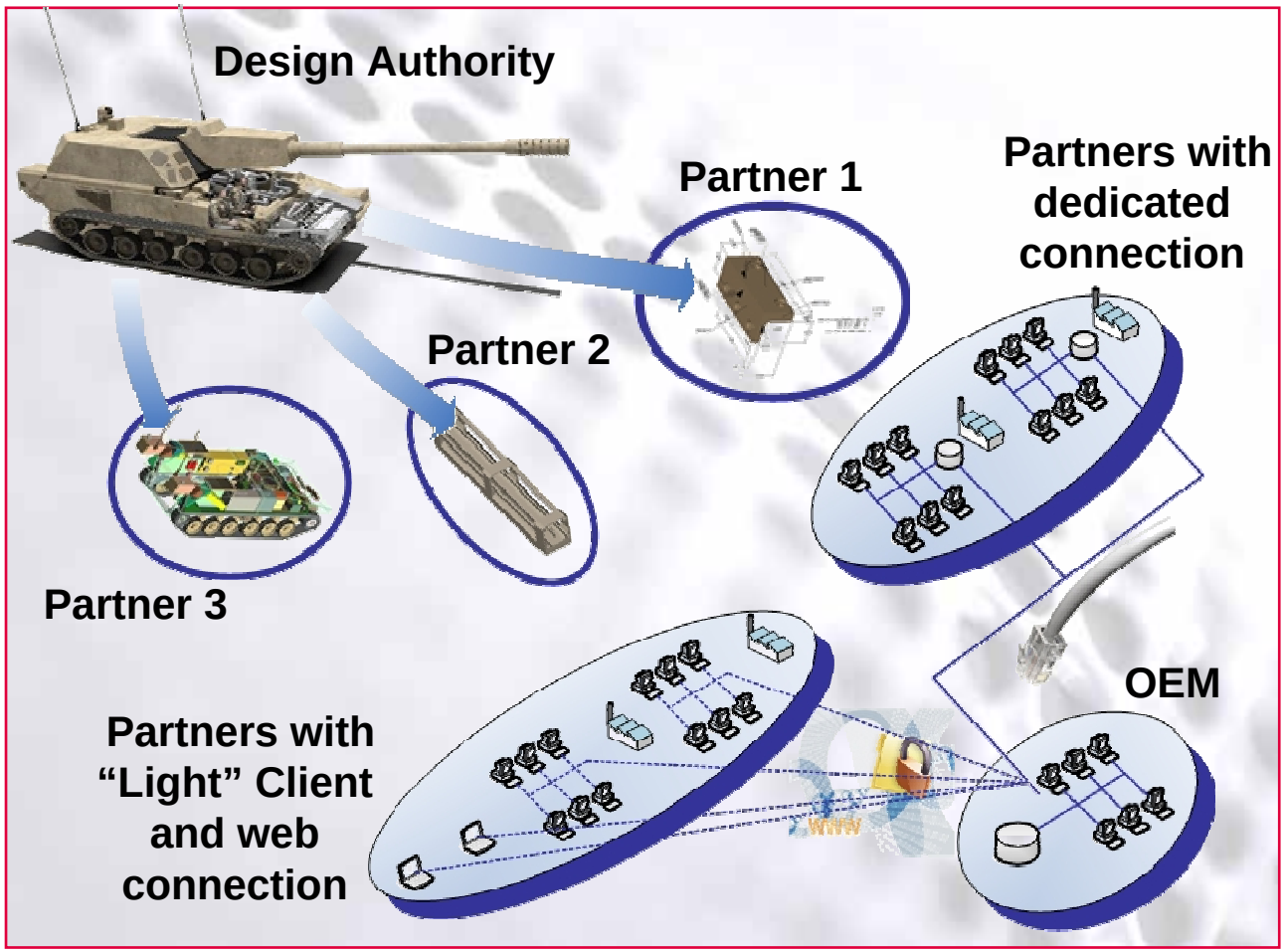








Supply Chain Integration

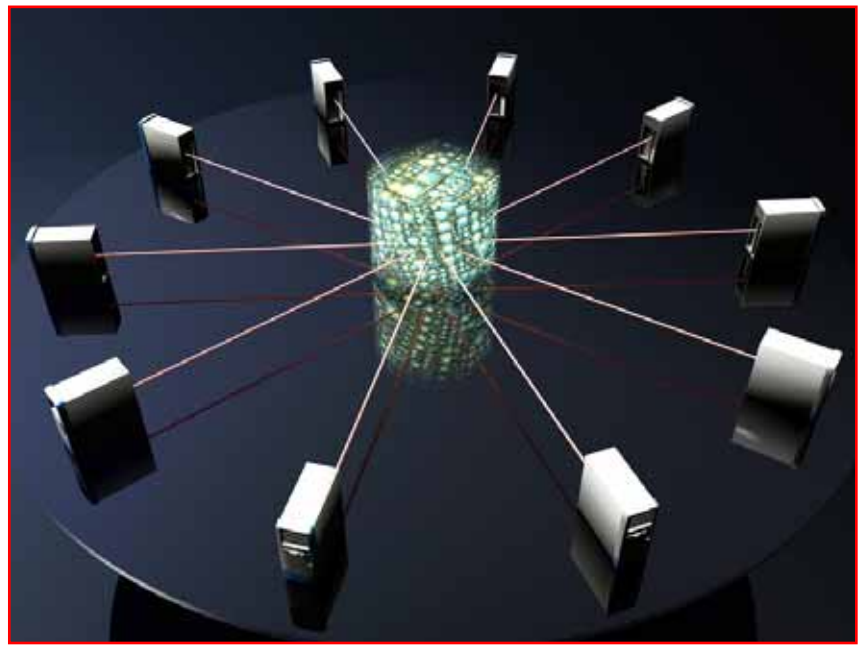


- Integrating the supply chain into the EPLM tool enables rapid delivery and update of the TDP
- It also ensures the reuse of the data vs. its recreation, reducing lead time and cost
- A further benefit is better control of the condition of supply and process through out the product lifecycle

Connectivity is key to efficiency and quick turn around

Delivering the TDP

- To be fully efficient the MBE process must have a delivery method that is CAD neutral, lightweight and free
- In addition, this delivery method must be secure
- To this end the MTO has selected Adobe as the delivery method of choice to both the customer and external supply chain
- The Adobe tools utilized are:
  - Digital Rights Management
  - 3D PDF
  - Portfolio

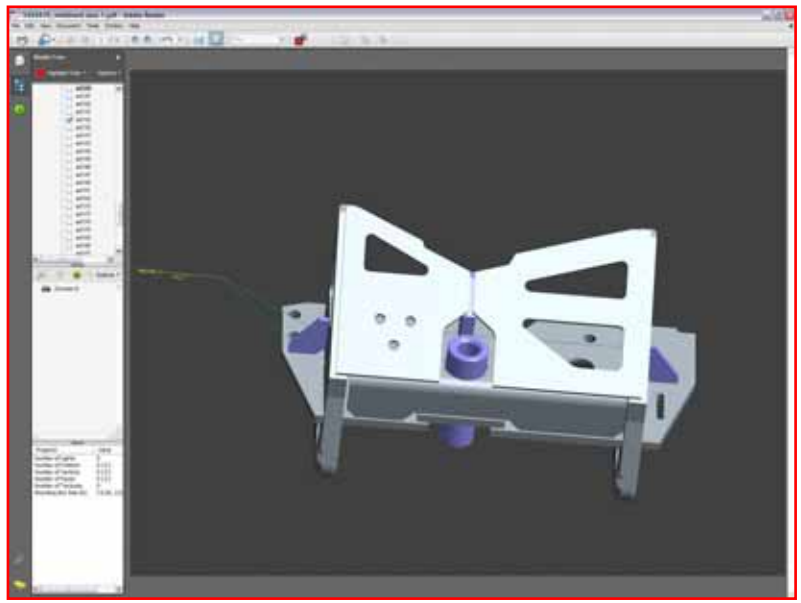


Digital Rights Management

- To insure the data is secure and that only authorized personnel use the data after it is downloaded we will utilize the Adobe Life Cycle Server
- Rights will be automatically assigned depending on what workflow is being activated, the user and the program in control of the data
- The rights applied are a combination of specific user and time restriction

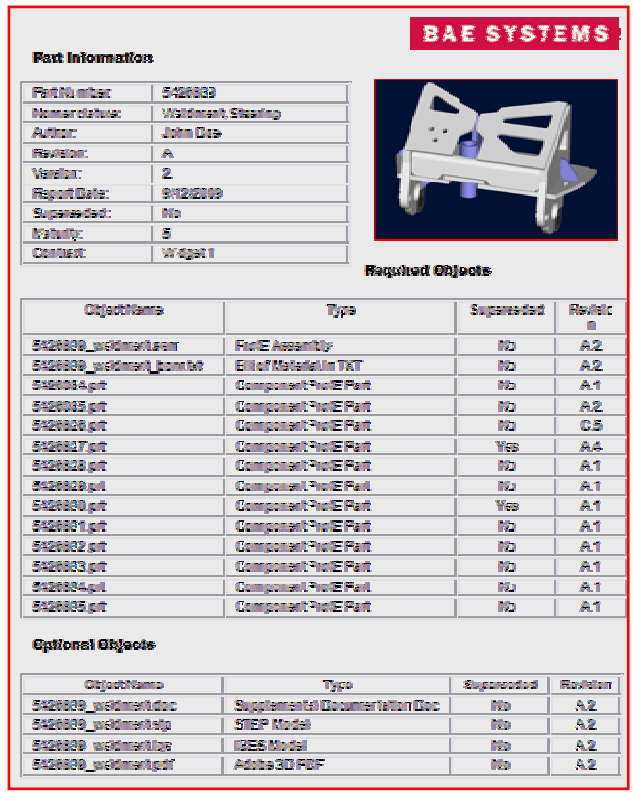
3D PDF

- To provide a CAD neutral method of delivering a fully annotated solid model that can be consumed without a workstation we are working with Adobe to develop its 3D PDF format
- Currently it will work for geometry and some annotations but it cannot currently support the MTO's organization techniques
- We are currently targeting 18 months for incorporation of this functionality



Portfolio

- To fully define a product more than one file is needed
- In order control these files as a single entity we will be using Adobe portfolio that is automatically generated by a PLM workflow
- The portfolio will have a dynamic coversheet that is populated by metadata passed to it from Windchill
- Other data types contained in the portfolio are:
  - Supplemental Data Documents
  - Native CAD Data
  - STEP and IGES files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Part Information

Part Number:	5426839
Nomenclature:	Weldment, Steering
Author:	John Doe
Revision:	A
Version:	2
Report Date:	9/12/2009
Superseded:	No
Maturity:	S
Context:	Widget1

Required Objects

ObjectName	Type	Superseded	Revision
5426839_weldment.asm	Pro/E Assembly	No	A.2
5426839_weldment_bom.txt	Bill of Materials in TXT	No	A.2
5426834.prt	Component Pro/E Part	No	A.1
5426835.prt	Component Pro/E Part	No	A.2
5426836.prt	Component Pro/E Part	No	C.5
5426837.prt	Component Pro/E Part	Yes	A.4
5426838.prt	Component Pro/E Part	No	A.1
5426839.prt	Component Pro/E Part	No	A.1
5426840.prt	Component Pro/E Part	Yes	A.1
5426841.prt	Component Pro/E Part	No	A.1
5426842.prt	Component Pro/E Part	No	A.1
5426843.prt	Component Pro/E Part	No	A.1
5426844.prt	Component Pro/E Part	No	A.1
5426845.prt	Component Pro/E Part	No	A.1

Optional Objects

ObjectName	Type	Superseded	Revision
5426839_weldment.doc	Supplemental Documentation Doc	No	A.2
5426839_weldment.stp	STEP Model	No	A.2
5426839_weldment.igs	IGES Model	No	A.2
5426839_weldment.pdf	Adobe 3D PDF	No	A.2

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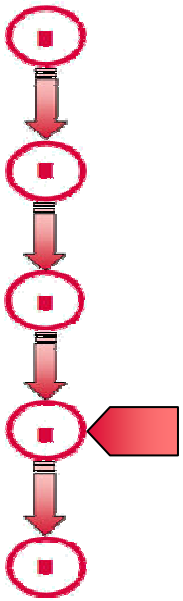


The BAE Experience

Implementing MBE at BAE

BAE MBE Experience

CY04		CY05				CY06				CY07				CY08				CY09		
Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3

NLOS-C & FCS MGV

ILAV

Increased use of MFG Simulation and first use of MBD models for production.

Full use of Virtual Manufacturing Suite and production from models only. Time from contract to market was 120 days.

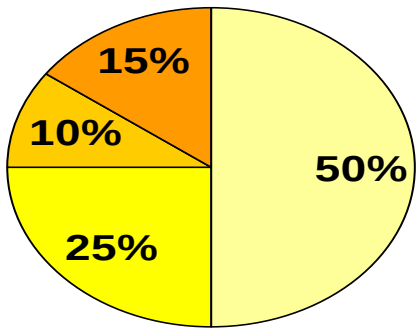
MRAP

MRAP built upon ILAV experience, drawings created after initial production start up. Also 8 variants designed to production in 90 days each.

JLTV

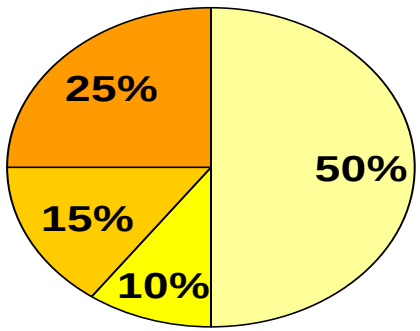
Effects of MBE Tech Transfer

Legacy Systems Approx Time To Market Breakdown:

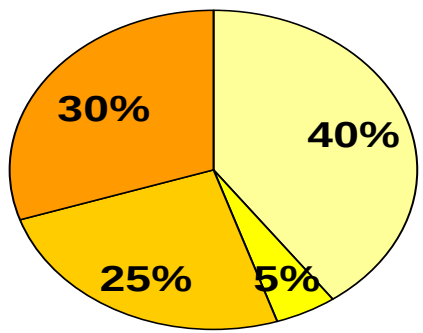


5+ Years To Market

Current Systems Approx Time To Market Breakdown:



Future Systems Approx Time To Market Breakdown:



3 Months – 2 Years To Market

Design Time | Drawing Creation | MFG Sim | Transition To Prod

Mine Resistant Ambush Protected (MRAP) Vehicle

- Since 2nd Quarter 07 we have:
  - Designed the base MRAP
  - Designed 8 major variants
  - Delivered approx 1100 vehicles
- In each case the vehicles were in production before a traditional 2D TDP was created (and then only at the customer request)
- Work instructions were created from the production model
- Produceablity was concurrent with design

The successes were enabled by “brute force” MBE

Red River Army Depot

- Red River Army Depot is the primary location for remanufacture of the Bradley Armored Fighting Vehicle
- We were sponsored by the Army Research Laboratory to implement MBE at that location
- In six months with no CAD experience they went from paper based to 3D work instructions for the Bradley transmission

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Closing

Wrapping It All Up

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Questions?

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And We Charge On!