

# IMS – US Team Model Based Enterprise Visualization Project Status

Jack Harris  
October 2, 2008

MBE :  
MODELING AND SIMULATION ACROSS THE LIFE CYCLE



## To be more effective and agile Industry must be able to .....

- Visualize Traditional Performance Simulations
- Visualize Manufacturing Performance
- Visualize Maintainability/Serviceability Performance
- Visualize on the fly changes across the life cycle
- All in an integrated environment

Visualization in the virtual world,  
leads to effective deployment in the real world

# US MBE WORK UNDER PDES INC CONSORTIUM

## Norway

EPM TECHNOLOGY

## Sweden

EUROSTEP

## UK

THEOREM SOLUTIONS  
BAE SYSTEMS

## Germany

LKSOFT

## France

AIRBUS

## United States

THE BOEING COMPANY

ADOBE

ROCKWELL COLLINS

COST VISION

SANDIA NATIONAL LABORATORIES/  
KCP

RAYTHEON MISSILE SYSTEMS

INTERNATIONAL TECHNEGROUP

GEORGIA TECH

GULFSTREAM

LOCKHEED MARTIN AERONAUTICS  
NORTHROP GRUMMAN

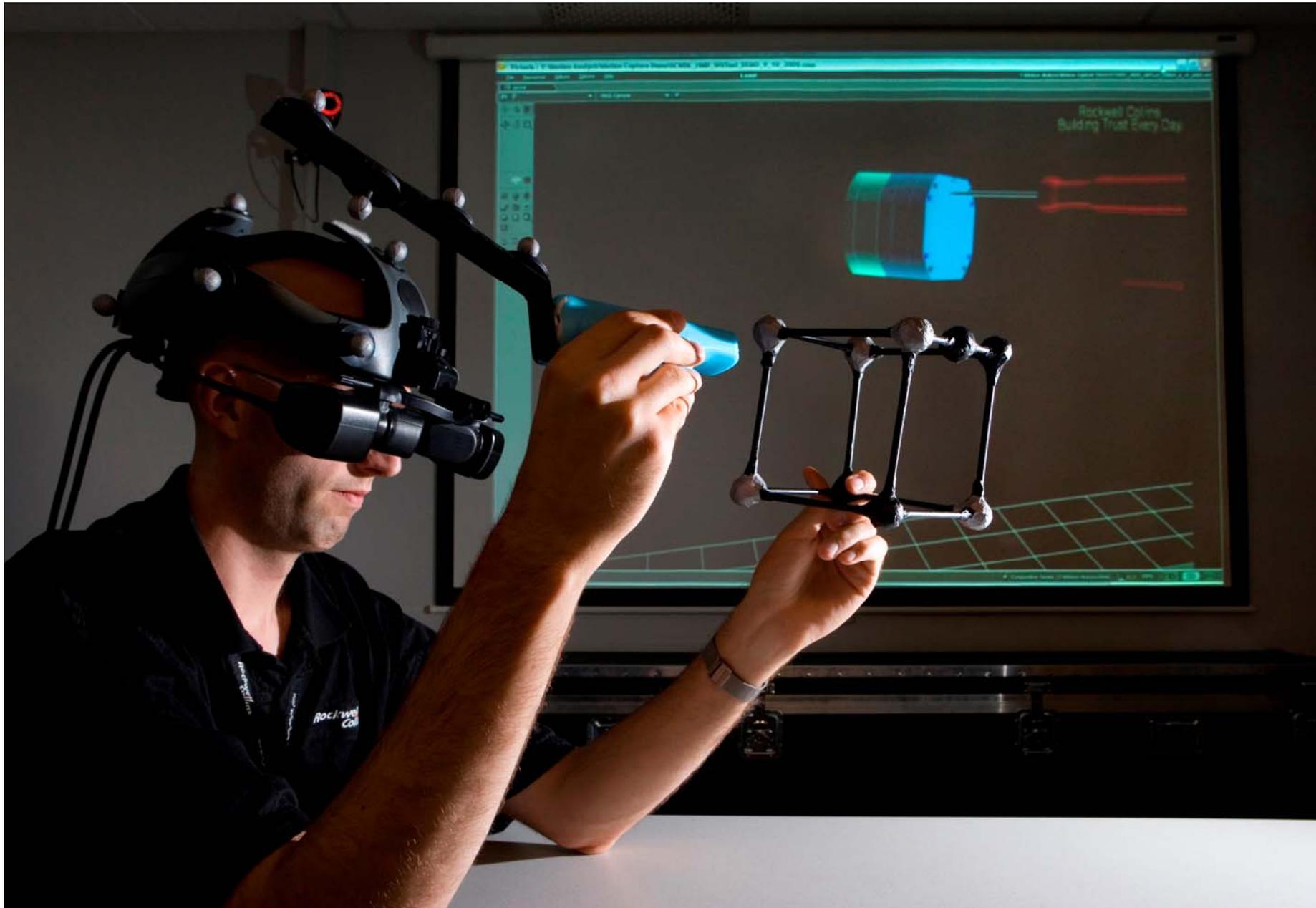
PTC

IBM

NARA  
NASA  
NIST  
U.S. ARMY

SCRA  
HOST CONTRACTOR







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**Memorandum of Agreement (MOA)  
among  
Manufacturing Technology Platform (MTP) Initiative Participants for  
Model Based Enterprise Visualization Development**

This Memorandum of Agreement (MOA) is made and entered into between the MTP Initiative Participants, hereinafter referred to as "the Participants".

**1. Purpose**

The purpose of this MOA is to establish a level of collaboration/cooperation among the Participants in the following Manufacturing Technology Platform Initiative:

The Model Based Enterprise Visualization project is structured to leverage multi region partners in a joint program to improve life cycle visualization capabilities. The visualization technology addresses, but is not limited to, 3D and Virtual/Augmented Reality. The deliverables will include development and demonstrations of various visualization technologies linked to enterprise modeling and simulation software.

**2. Background**

This activity started as a joint collaboration of U.S. aerospace and defense companies under the international consortium: PDES Inc. The work has included transitioning from Mechanical CAD and analysis outputs into 3D and virtual reality. This has proven to be of great value as an overall enabler to improving business performance and in enhancing the ability to provide a more optimal design solution.

The structure of the US team under PDES Inc, not only leverages an existing international consortium, but also a proven legal structure for protecting Intellectual Property (IP). The combination of the US and other IMS regions under PDES Inc. will create a project team that will provide an opportunity for greater diversity of innovative input, and therefore a more encompassing solution. The combination of the PDES Inc. team and members from other IMS regions offers the real possibility of a global solution to the MBE/Visualization.

**3. Relationship of the Participants**

Participants must be part of a Region represented in the overall IMS Program and working on a Manufacturing Technology Initiative that has been sanctioned by the IMS Heads of Delegation.

**4. Proprietary Information**

During the term of this Agreement, it is expected that the Participants will collaborate in an open R&D environment to the fullest extent possible. Should the collaboration

require discussion of proprietary information, the participants may enter into separate Non-Disclosure Agreements (NDA) and inform the IMS Secretariat accordingly.

**5. Review**

The Participants of this Agreement will review and align the efforts established under this Agreement on a regular basis, as required.

**6. Term and Termination**

This Agreement shall continue in full force and effect for two (2) years from the date of the last signature on this Agreement or until the Agreement is terminated. Any Participant may terminate this Agreement by providing ninety (90) days written notice to the other Participants and the IMS Secretariat.

**7. Obligation of the Participants**

Initiative Participants agreed to meet and review technical accomplishments at least twice a year in conjunction with scheduled IMS ISC meetings. Each Participant or Region, as appropriate, will bear all travel/participant costs incurred by it arising out of its obligations and efforts under this Agreement. **This Memorandum of Agreement is not a contractual obligation between the Participants.**

**Participant**

By: 

Name: Jack R. Harris  
*(printed/typed)*

Title: General Manager, PDES Inc.

Date: September 30, 2008

By: 

Name: Michael R. Jahadi  
*(printed/typed)*

Title: Senior Manager, Lockheed Martin Corporation

Date: September 30, 2008

**Regional Secretariat**

By: \_\_\_\_\_

Name: \_\_\_\_\_  
*(printed/typed)*

Title: \_\_\_\_\_

Date: \_\_\_\_\_

By: 

Name: Jim Lorenz  
*(printed/typed)*

Title: Manager, Rockwell Collins

Date: September 30, 2008

**MAJOR PROJECT PLAYERS:**

- Lockheed Martin
- Rockwell Collins
- Iowa State University
- Mechdyne Corp.
- Adobe
- Boeing
- Raytheon
- AIRBUS
- Theorem Solutions

**PROSTEP FROM GERMANY IS CONSIDERING PARTICIPATION**

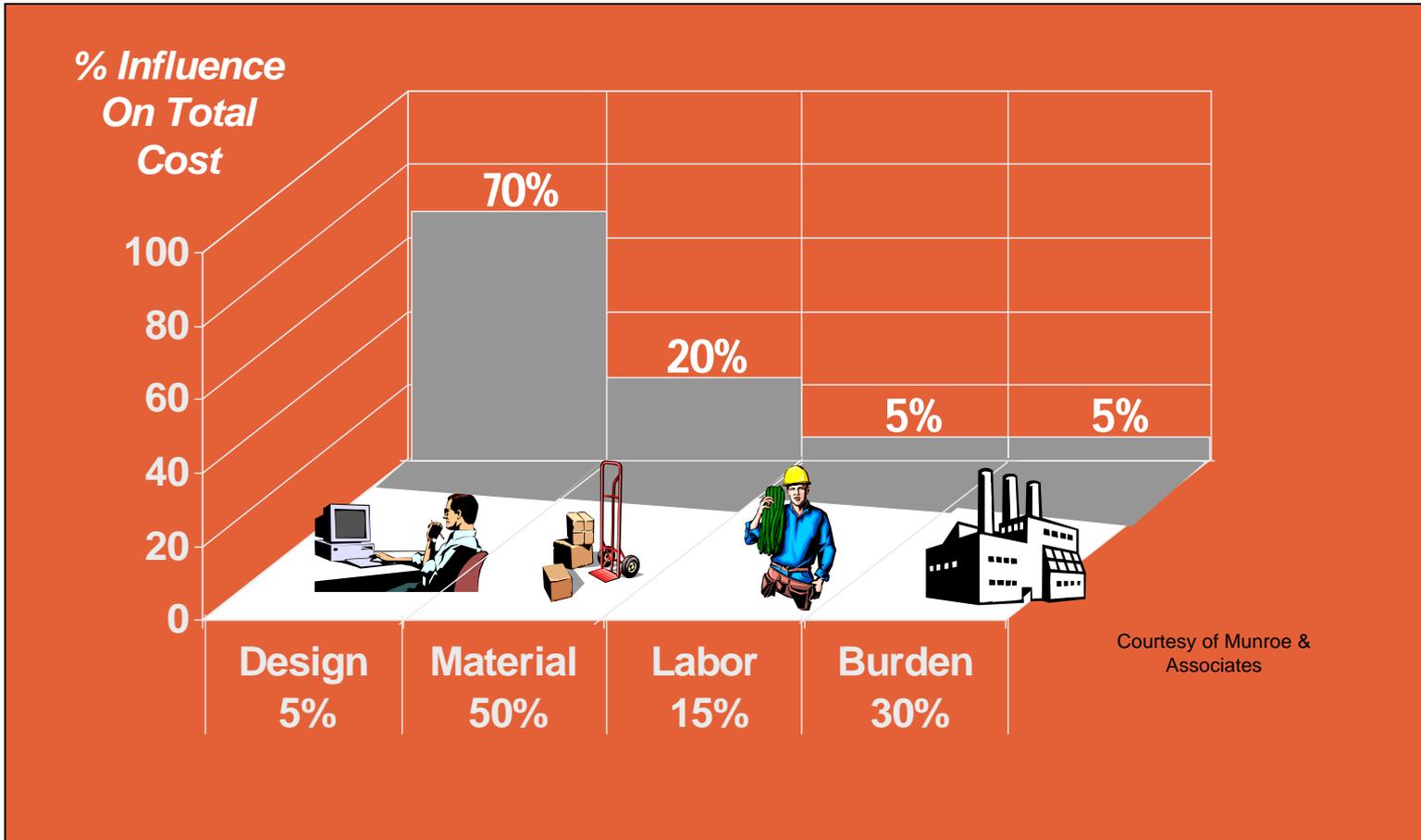




# Back Up Slides

***Rockwell  
Collins***

Industry has known this for years.....



- U.S. Industry is working to implement a solution.... Integrated Life Cycle Decision Making, aka the Model Based Enterprise

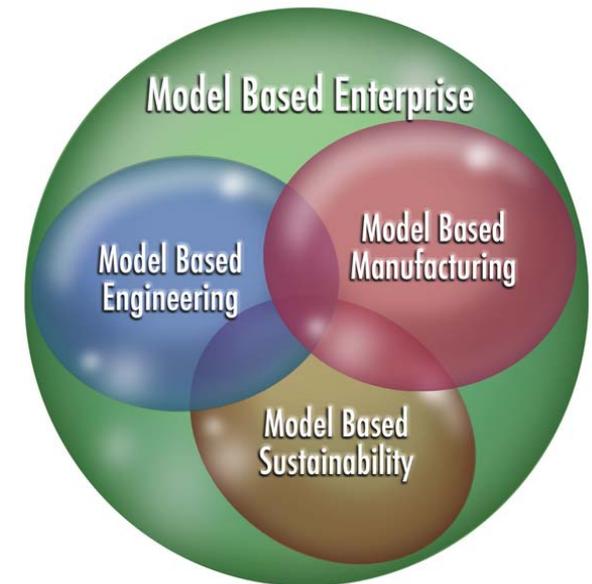
- In 2004, an Industry team comprised of Boeing, Lockheed Martin, Raytheon Missile Systems, Rockwell Collins and Sandia National Labs launched an effort to evaluate collaboration in this area
- This initial team has now morphed into a combined effort of the U.S. NGMTI and PDES Inc. MBE teams
- The team briefed at the Defense Manufacturing Conference in December 07 and at the Marcus Evans Defense Manufacturing Summit in February 08



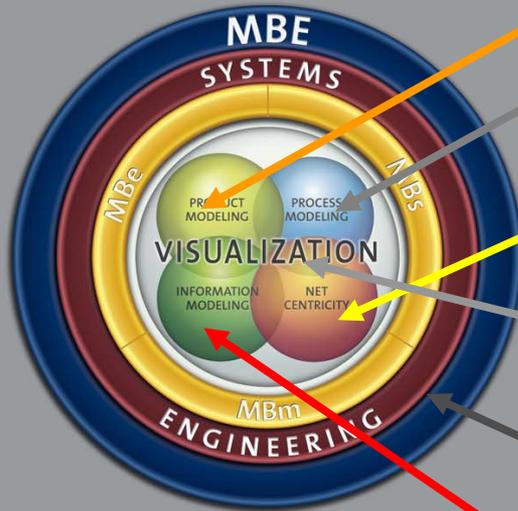
## *Industry has defined the MBE as.....*

*An integrated environment that enables multi-disciplinary decision making addressing the entire life cycle*

- Models are defined as information abstractions from enterprise data for application in domain specific use
- Tools and processes are integrated through the application of standard information
- Information is accessible through PLM interfaces
- Key Life Cycle Characteristics predicted through math and science based simulation



## Model Based Enterprise (MBE).



Product modeling assesses end item performance against life cycle requirements

Process modeling assesses process related performance against life cycle requirements

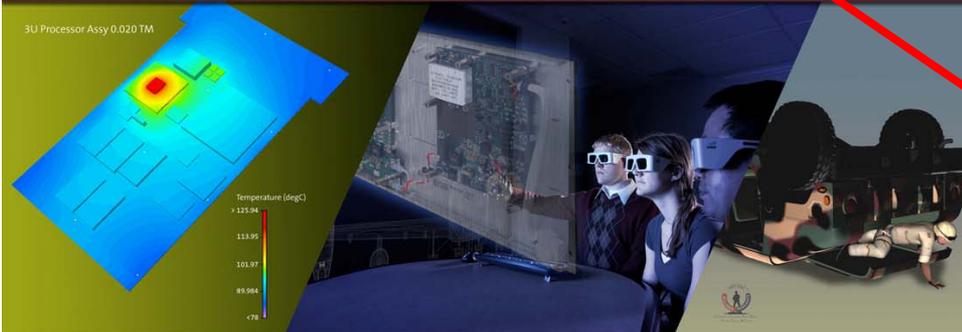
Whether MBe, MBm or MBs, Net Centricity ensures the availability of managed information at the right place and time, supporting multi functional decision making and execution across the extended enterprise

Improved effectiveness of the MBE is achieved through state of the art visualization

The wrapper around MBe, MBm and MBs is Systems Engineering which manages and provides traceability of requirements throughout the life cycle

Information modeling incorporates standard formats to ensure interoperability of like and cross domain decision making tools and processes

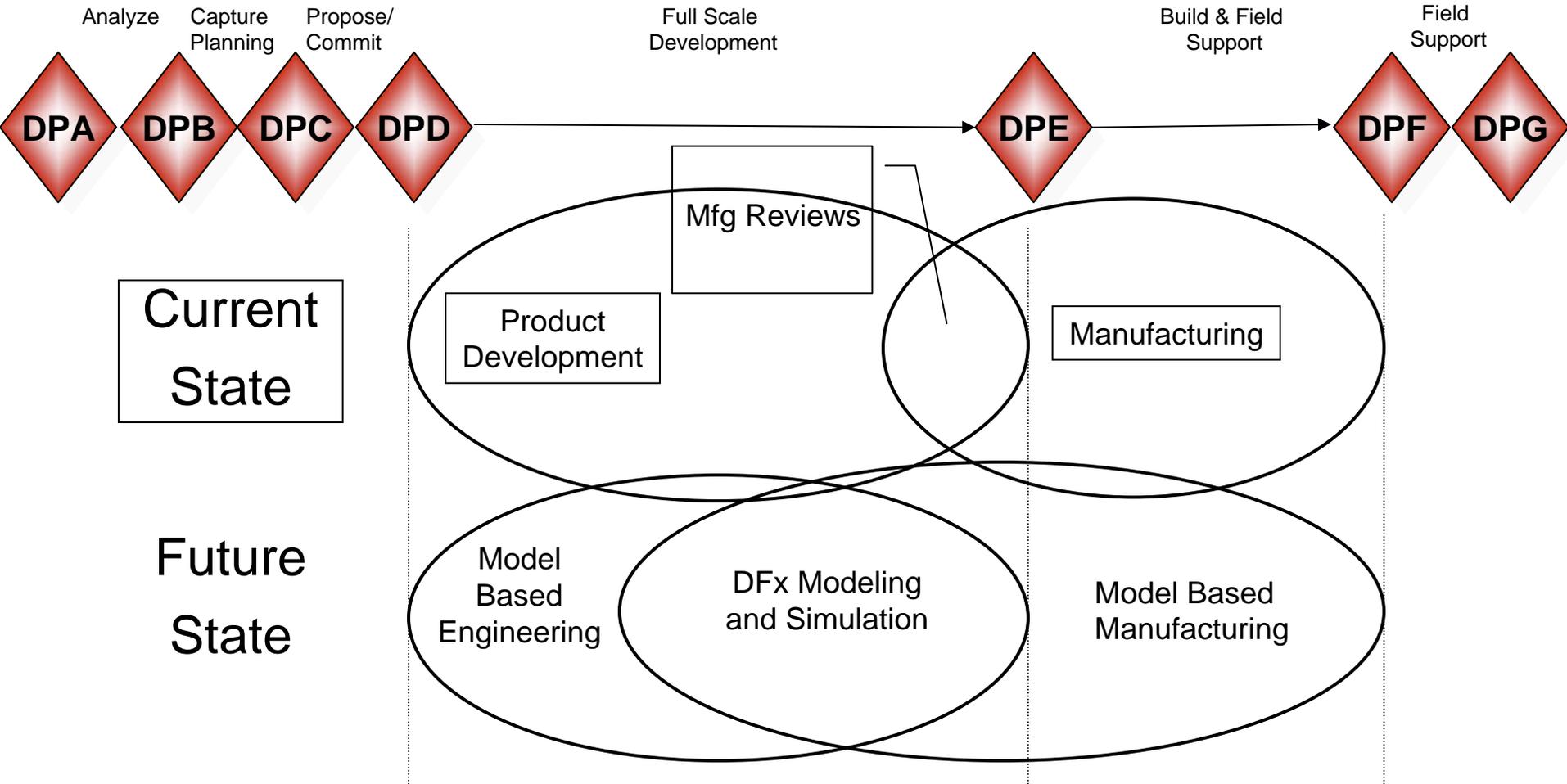
### SYSTEMS ENGINEERING



Model Based Engineering (MBe)

Model Based Manufacturing (MBm)

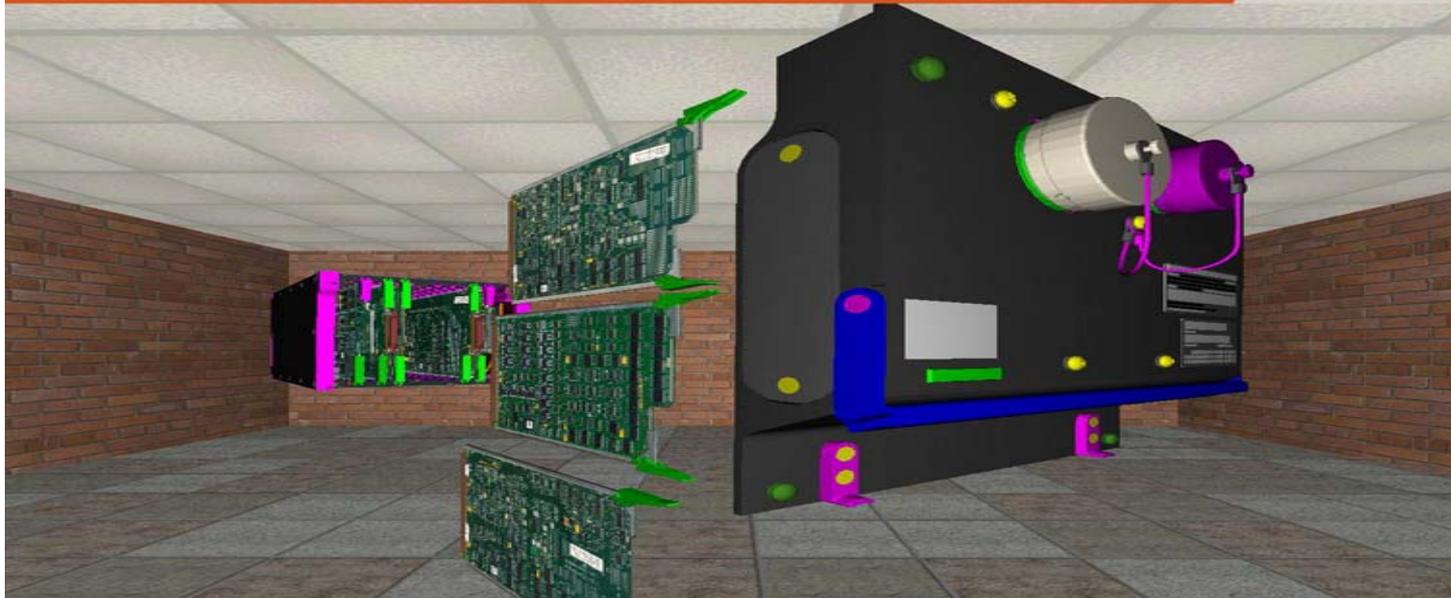
Model Based Sustainment (MBs)



Without process rigor, the best of breed/integrated tools won't provide the desired outcome

**MODEL BASED MANUFACTURING**

Enhances performance through integrated simulation and visualization environments.

**Product Modeling**

- > Optimize design implementation
- > Reduce prototype investment
- > Improve manufacturing yield

**Information Modeling**

- > Interoperability of like domain tools
- > Interoperability of cross domain tools
- > Reduce life cycle costs

**Process Modeling**

- > Improve process efficiency
- > Reduce manufacturing variation
- > Enhance inventory management

**Net Centric Manufacturing**

- > Improve supply chain management
- > Increase effectiveness of manufacturing execution within the enterprise
- > Enhance customer communication



## The good news.....

- Domain specific tools have significant functionality
- Enterprise business tools have gained robustness

## OK, so.....

- Gaps in modeling and simulation tools exists
- Interoperability is a obstacle
- Process management a necessity

MBe – Model Based Engineering  
 MBm – Model Based Manufacturing  
 MBs – Model Based Sustainment

### Active Project: Systems Engineering (AP233)

Participants:

- NIST
- Eurostep
- NASA
- ATI

### Active Project: MBE-IF Testing

Like Domain Participants: Cross Domain Participants:

- |                     |                     |
|---------------------|---------------------|
| • PTC               | • PTC               |
| • Theorem Solutions | • Theorem Solutions |
| • LKSoft            | • CostVision        |
| • MSC               | • EuroSTEP          |
| • Georgia Tech      |                     |
| • DataKit           |                     |
| • SFM Technology    |                     |

### Active Project: Engineering Analysis - STEP Composites and CAE Visualization in Adobe Acrobat

Participants:

- Adobe Systems
- Lockheed Martin Aeronautics
- Boeing

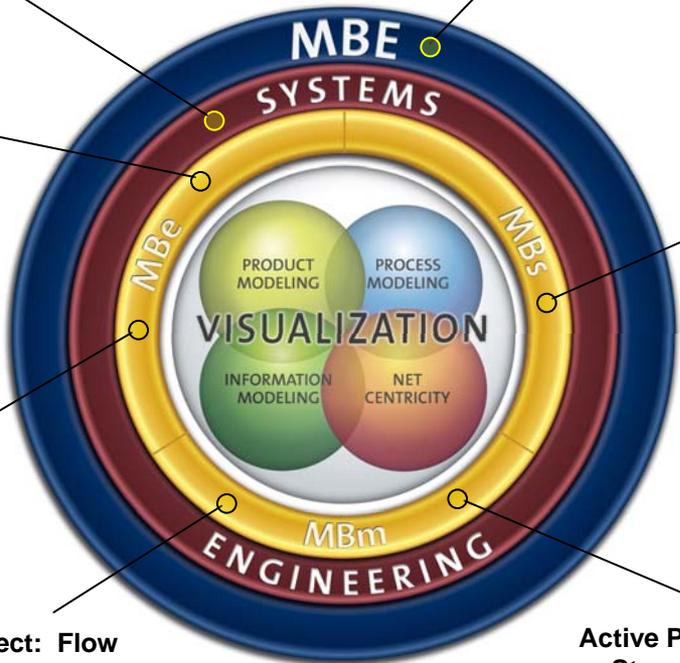
### Active Project: System Life Cycle Support

Participants:

- US Army
- Eurostep
- PTC
- NIST

Potential MBe Project:  
 ECAD/MCAD Integration

Potential MBs Project:  
 Long Term Data Retention



### Active Project: EM Pilot – Warpage Simulation

Participants:

- Georgia Tech
- InterCAX
- LKSoft
- Rockwell Collins
- NIST

### Active Project: Flow Equivalent Servers

Participants:

- Georgia Tech
- Boeing
- Raytheon Missile Systems
- Lockheed Martin
- Rockwell Collins
- NIST

**Potential MBm Projects:**

- Next Generation Supply Chain Modeling
- Integrated Flow Modeling and Physical Layout
- Design For Ergonomics
- Cognitive Virtual Environment

### Active Project: Value Stream Mapping

Participants:

- Georgia Tech
- Boeing
- Raytheon Missile Systems
- Lockheed Martin
- Rockwell Collins
- NIST



**PDES, Inc.**

## Model Based Manufacturing Objectives

- Implement 3D modeling and simulation
  - Feedback on producibility and product simplification during design
  - Replace **build–test–redesign** paradigm with **model–test–build** paradigm
  - Lower initial product costs by maturing designs through modeling
- Early and accurate cost estimation
  - Verified cost models for negotiations and trade studies
- Integrate human factors and ergonomic analysis
- Connect design efforts to the manufacturing capability
- Close the loop with shop floor control

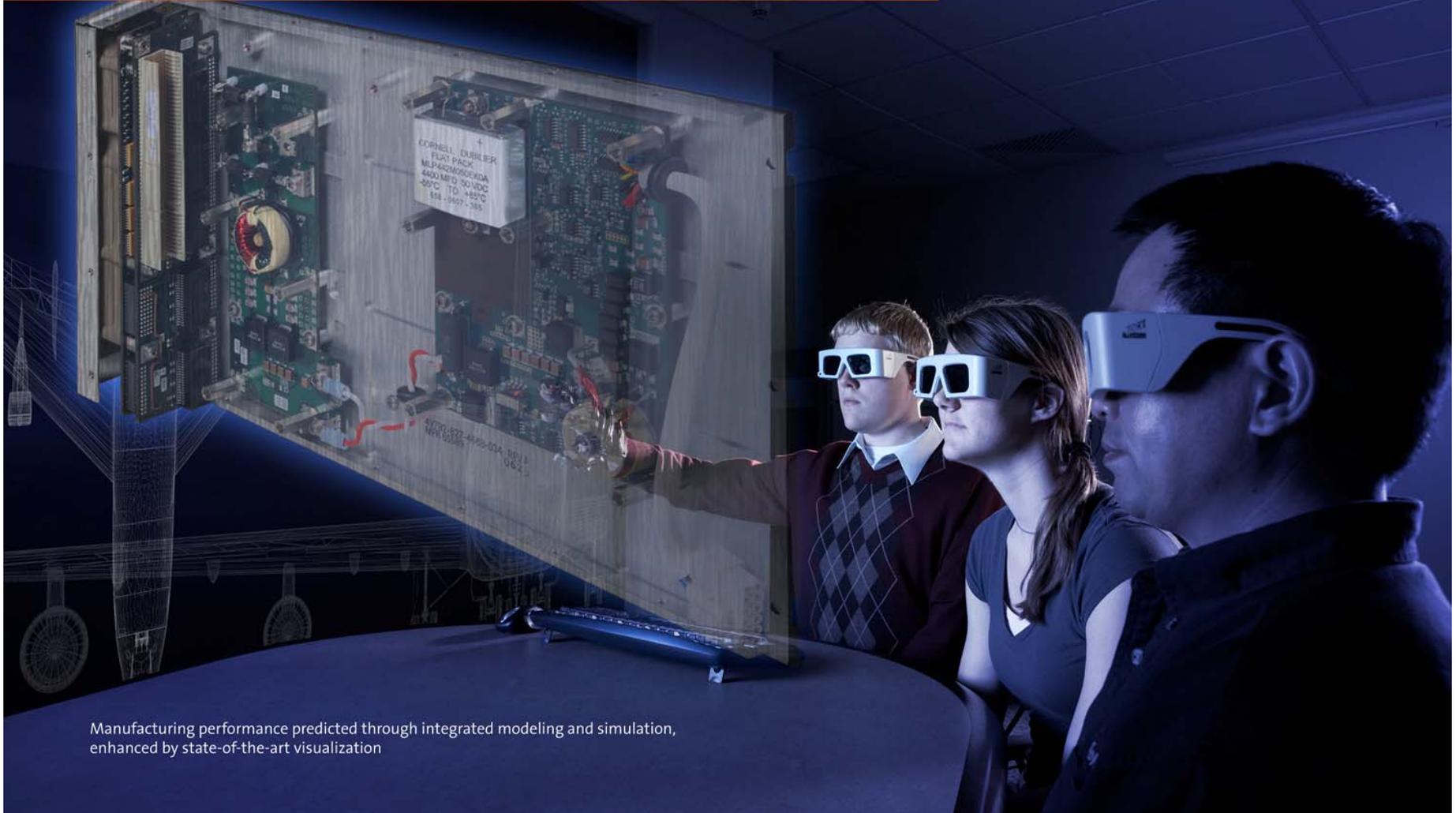


**Model Based Manufacturing completes the collaborative design environment between Operations, Engineering, and Supply Chain**

## State of Art Visualization improves a team's decision making ability



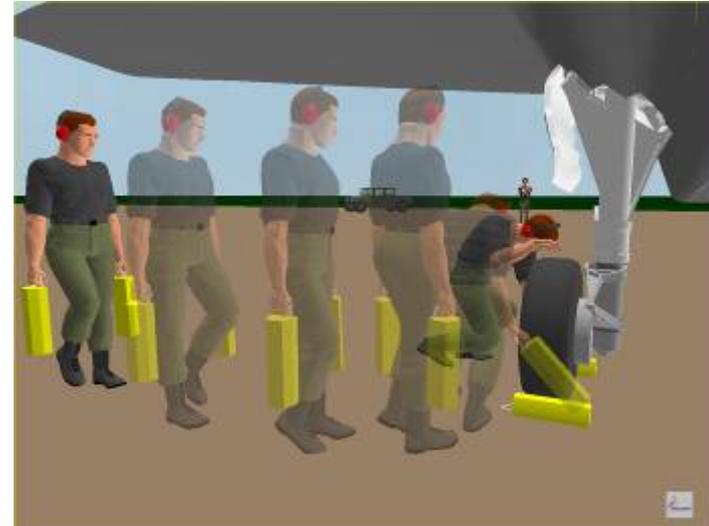
Model Base Manufacturing, a component of Model Based Enterprise, delivers superior solutions at lower cost.



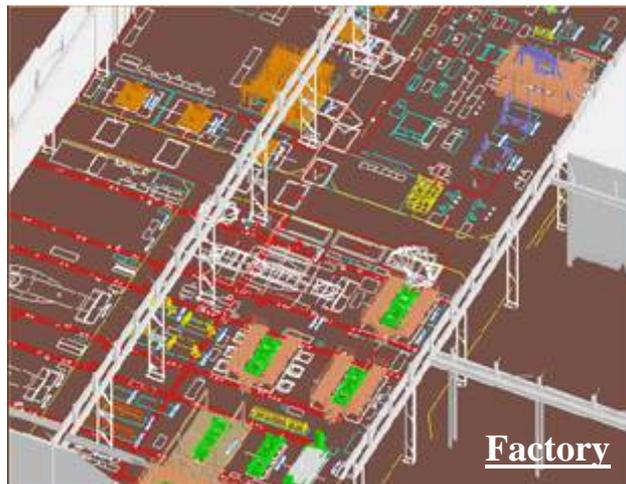
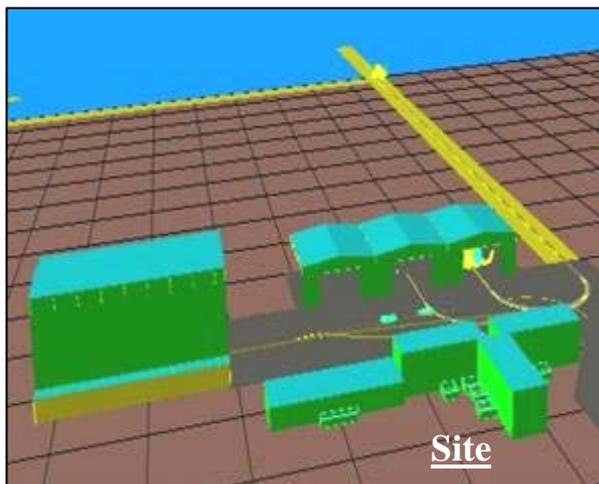
Manufacturing performance predicted through integrated modeling and simulation, enhanced by state-of-the-art visualization

## Cost Effective Maintainability Analysis

- Real time motion capture posturing (over 70% Reduction in Engineering labor per Ergo study)
- Allows for high resolution look at problem areas
- Reduce labor time to build simulation and to complete analysis
- Availability to a full-scale Immersion System (CAVE/HMD)



## Discrete Event Simulation



### *Tooling & Resource Utilization / Labor Requirements*

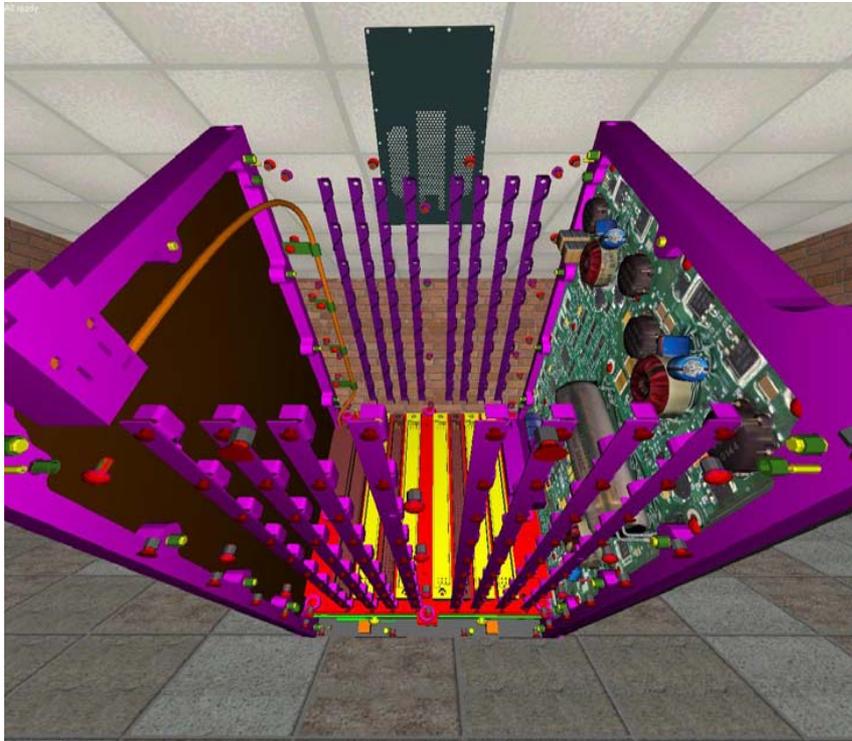
#### **Programs:**

- ◆ **Boeing Commercial Airplanes (BCA)**
  - ◆ 737 / 747 / 777
- ◆ **Aircraft & Missiles (A&M)**
  - ◆ F/A-18E/F / Chinook
  - ◆ F/A-18EFF / DD-21 / V-22
- ◆ **Space & Communication (S&C)**
  - ◆ Space Shuttle / NMD / SLI / LMARS

#### **Benefits:**

- ◆ Validates labor requirements
- ◆ Provides tooling and resource utilization requirements
- ◆ Assesses capacity, cycle time, throughput
- ◆ Evaluates alternative process scenarios
- ◆ Enables optimization of process flow

## *Example of collaborative project in Model Based Manufacturing*



***Standard Information being used to support lightweight visualization***

***Next Generation Human Model being evaluated to support Ergonomic design***

