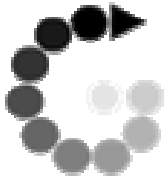


NEXT GENERATION
MANUFACTURING TECHNOLOGY INITIATIVE

Next Generation Manufacturing Technology Initiative and the Model-Based Enterprise

NDIA Systems Engineering Conference
San Diego, California
October 26, 2005

Richard Neal - IMTI
Gerry Graves - ATI
Leo Reddy - NACFAM

Strategies for Manufacturing Technology Management

IMTI
Integrated Manufacturing Technology Initiative

Present	Future	Result
Information	The Manufacturing Analyst for Science and Technology	The Automated Knowledge Discovery System	Unprecedented Instant Access to Exactly What YOU Need to Know
Plans	A Rich Set of Technology Roadmaps	Comprehensive Manufacturing Technology Management Plans	Dramatic Improvement in ROI From YOUR R&D Investment
Solutions	Implementation Plans Singular Wins	Focused Technology Investment for Business Success	A Revolution in Manufacturing

The NGMTI Team

***Three non-profit organizations with strong expertise and experience in facilitating collaborations*.**

- **IMTI: a technology/research management organization with a mission to support the nation's manufacturing infrastructure**
- **NACFAM: a long-term builder of leadership-level, nationwide manufacturing technology public-private partnerships**
- **ATI: a deeply experienced manager of advanced manufacturing technology research collaborations.**

NEXT GENERATION
MANUFACTURING TECHNOLOGY INITIATIVE

"NGMTI is dedicated to transforming the U.S. manufacturing base through technology driven innovation"

Importance of Manufacturing to Innovation

- **Drives innovation: Manufacturers invest $135 billion annually in R&D, which is 70% of industry R&D investment and more than all federal R&D**
- **Innovative mfg process technologies are *the most effective means* to reduce China's low-wage advantage**
- **Yet industry gives low priority to process technologies and is moving R&D offshore**
- **Only 2% of federal $132 billion R&D budget spent on basic and applied manufacturing tech**
- **Manufacturing R&D has never been a White House "Grand Challenge"**

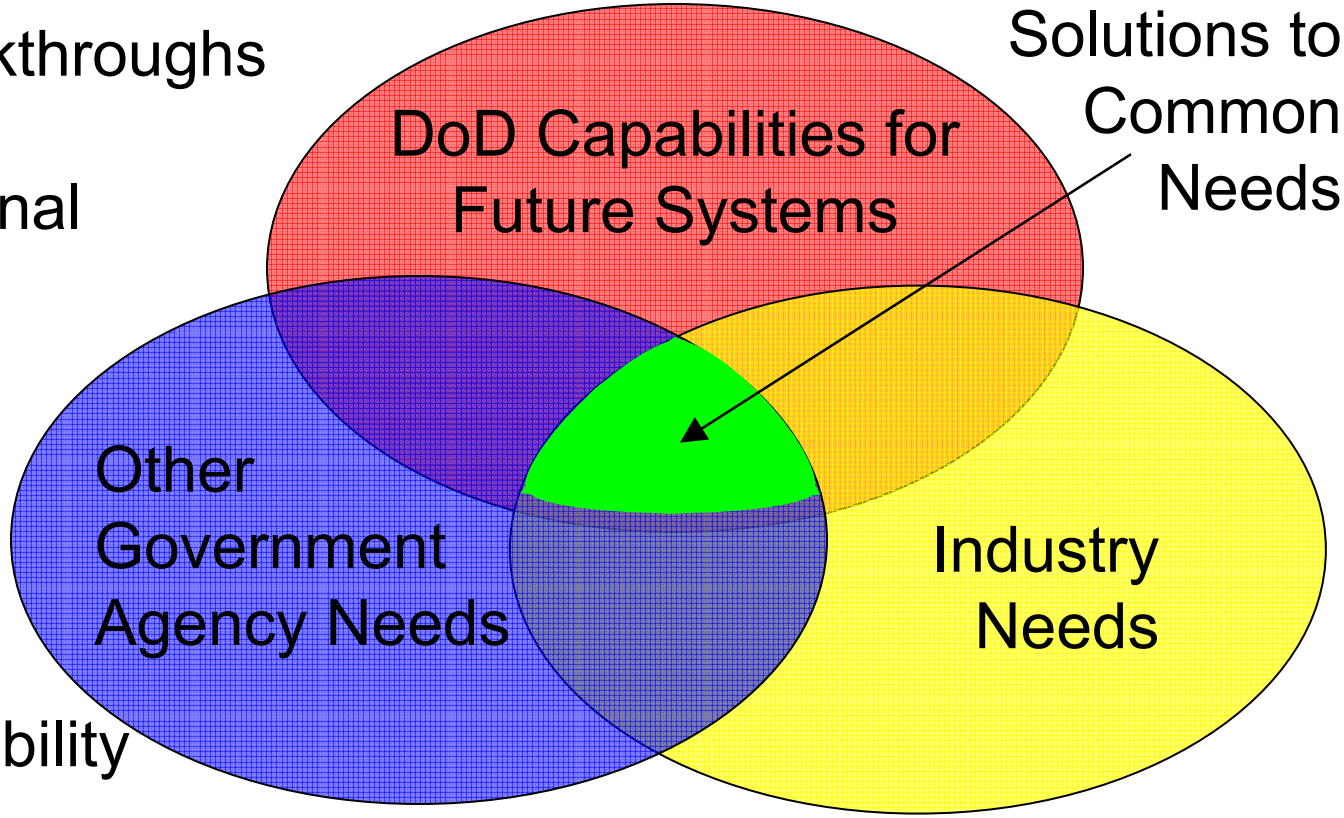
NEXT GENERATION MANUFACTURING TECHNOLOGY INITIATIVE

The NGMTI Solution

- Provides a mechanism for building and executing an innovative manufacturing R&D strategy for both economic growth and national security goals
- Represents a sustainable organization meeting critical success factors: strategic planning, industry-government collaboration, national tools
- Coordinates research and development projects focused by strategic investment plans
- Leverages university, federal, industrial labs, and research consortia nation-wide

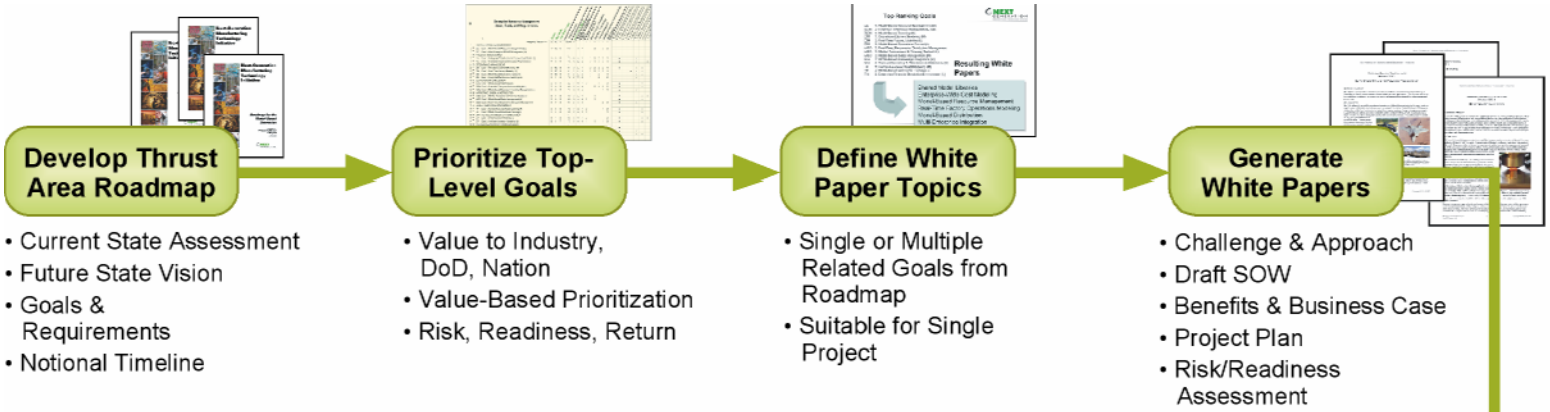
NGMTI Provides for Future Common Needs

- Provide breakthroughs that produce transformational technologies
- Provide technologies that improve affordability and sustainability
- Create innovative opportunities for fast response manufacturing of new products



NEXT GENERATION MANUFACTURING TECHNOLOGY INITIATIVE℠

Implementation/Transition Plan



Develop Thrust Area Roadmap
- Current State Assessment
- Future State Vision
- Goals & Requirements
- Notional Timeline

Prioritize Top-Level Goals
- Value to Industry, DoD, Nation
- Value-Based Prioritization
- Risk, Readiness, Return

Define White Paper Topics
- Single or Multiple Related Goals from Roadmap
- Suitable for Single Project

Generate White Papers
- Challenge & Approach
- Draft SOW
- Benefits & Business Case
- Project Plan
- Risk/Readiness Assessment

Industry/SME Reviews
- Validate Challenge & Approach
- Refine SOW & Plan
- Begin "Engagement" Process

Launch Projects
- Form Teams
- Finalize SOW & Plan
- Secure Funding (Federal Agency & Industry Investment)

Develop Technologies
- Industry Collaborative
- Focused Corporate R&D
- Govt-Funded (e.g., SBIR)
- Leverage NGMTI TestNet

Deliver Breakthroughs
- NGMTI Experiments & Pilots
- Industry Commercialization
- Technology Deployment to Defense Industrial Base

NGMTI Thrust Areas

- Emerging Process Technologies
- Model-Based Enterprise
- Safe, Secure, & Reliable Manufacturing Operations
- Enterprise Integration
- Intelligent Systems
- Knowledge Management

Model-Based Enterprise Prioritization

Roadmap contains 80 Goals w 300 Requirements

KT Analysis

Top 20 Goals

Compilation of Important Themes

15 White Papers

Previous Workshops

Interviews

Web-Based Search

Literature

Cross Cutting

Topic Specific

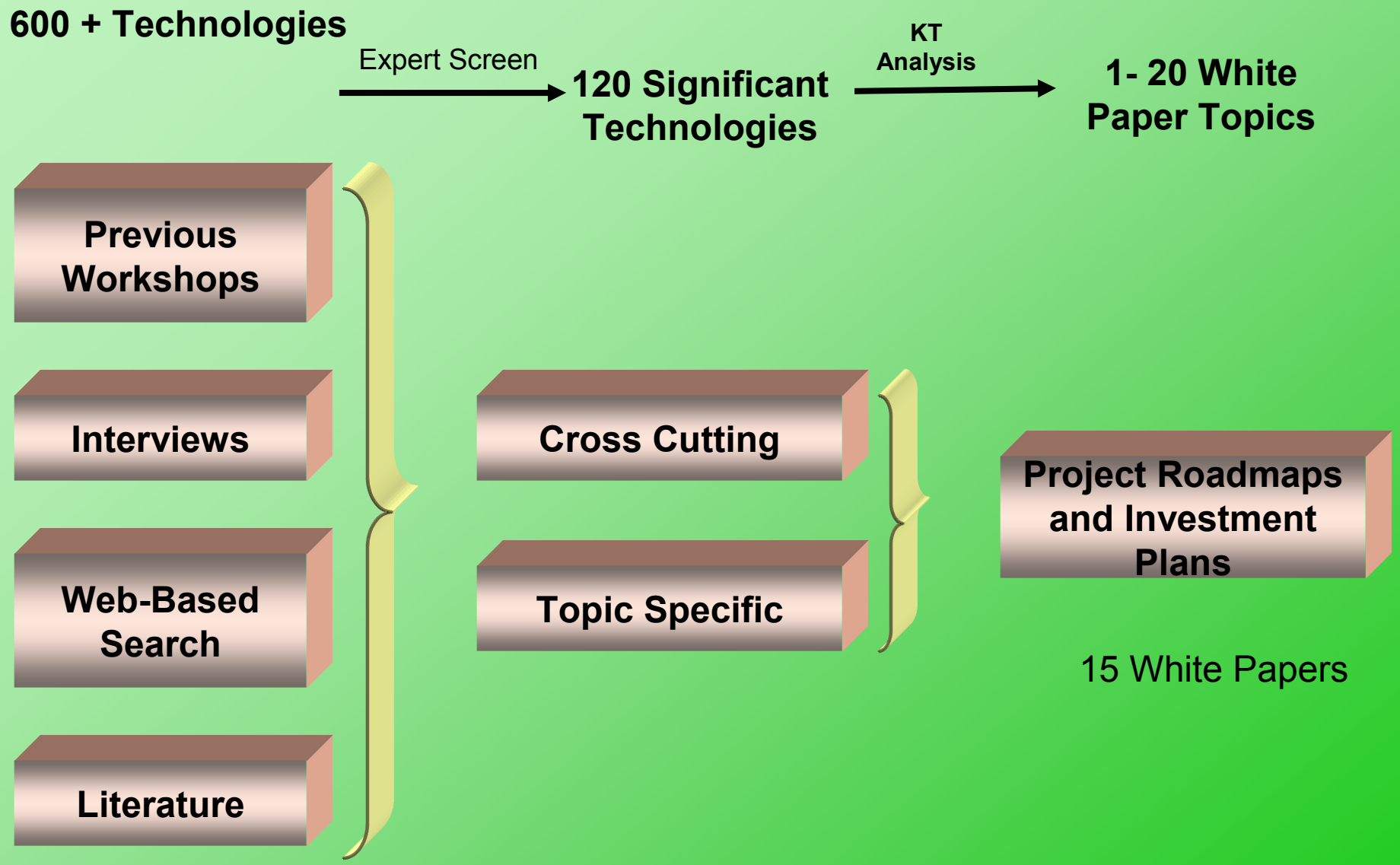
Project Roadmaps

- Product Realization
- Resource Management
- Strategic Management

Model-Based Enterprise White Papers

- Flexible Representation of Complex Models
- Shared Model Libraries
- System-of-Systems Modeling for the Model-Based Enterprise
- Enterprise-Wide Cost Modeling
- Intelligent Models
- Configuration Management for the Model-Based Enterprise
- Product-Driven Product & Process Design
- Model-Based Product Life-Cycle Management
- Model-Based, Real-Time Factory Operations
- Model-Based Distribution
- Multi-Enterprise Collaboration
- Model-Based Resource Management
- Information Delivery to Point of Use

Emerging Process Technologies



EPT White Papers

NEXT GENERATION MANUFACTURING TECHNOLOGY INITIATIVE

- Low-Cost Titanium Powder Production
- High-Frequency Laser Machining
- Friction Stir Joining Technologies
- Improved Thin-Film Processes for Semiconductor Fabrication
- Microreactors & Processing Methods
- Digital Direct Manufacturing
- Affordable, Lightweight Large Structural Composites Manufacturing
- Nanomaterials for Glass Coatings
- Smart, Reconfigurable Multifunction Machine Tools
- Thin-Film Coatings for Paint Elimination
- Manufacturing Applications for Carbon Nanotubes
- Advanced Aerospace Casting Processes
- Precision Optical Finishing
- Hybrid Bearing Manufacture
- Military Fuel Cell Technology

NGMTI Current Status

- 28 project plans developed for MBE and EPT, with “High-interest” from both defense and commercial firms
- Project teams now being formed for 13 of the White Paper topics
- MBE Forum being planned for the fall

The NGMTI Thrust Areas

- Model-Based Enterprise
- Emerging Process Technologies
- Safe, Secure, Reliable, and Sustainable Manufacturing Operations
- Enterprise Integration
- Intelligent Systems
- Knowledge Applications

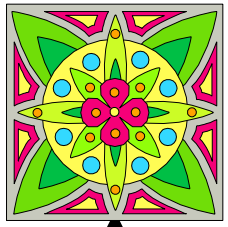
Model-Based Enterprise: A Single Objective

- MBE - an integrated digital environment for addressing all aspects of the enterprise
- Requires total sharing of information between all elements of the enterprise.
- New approaches and toolsets are required

Prioritization to Establish What to Do, When

Model-Based Enterprise: The Views

Product Realization



Enterprise Integration

Business Management

Enterprise Management

Such an Enterprise Will Be. . .

Thanks to the NNSA for sharing jointly developed visuals and concepts!

Totally Connected

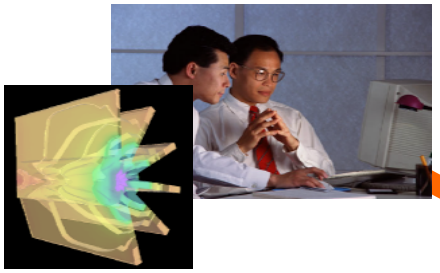
NEXT GENERATION MANUFACTURING TECHNOLOGY INITIATIVE

An Integrated Seamless Flow of Information and Knowledge

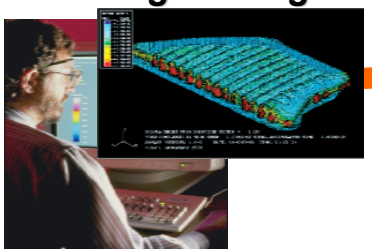
Knowledge Rich

NEXT GENERATION MANUFACTURING TECHNOLOGY INITIATIVE

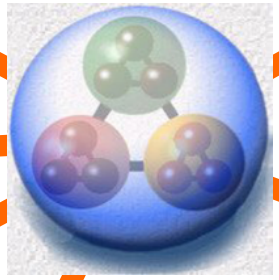
Product Design & Engineering



Process Design & Engineering



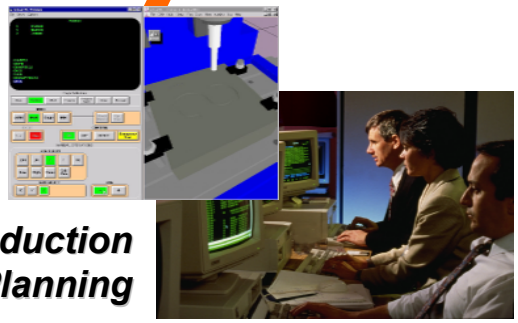
Shared Knowledge



Manufacturing Operations

Product Assurance

Inspection, Acceptance & Certification

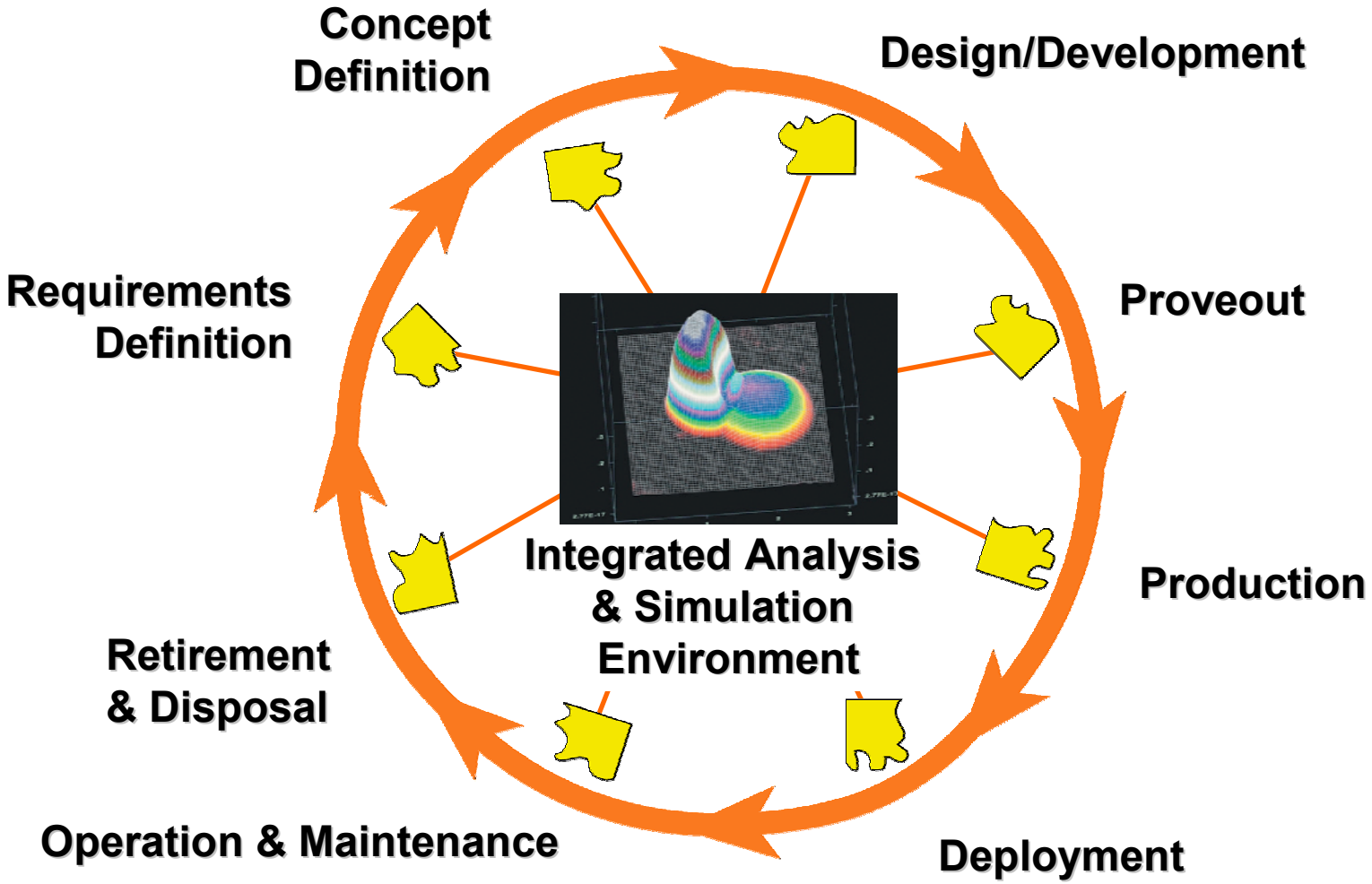


Production Planning

Continuous feedback and enrichment of information across the life cycle

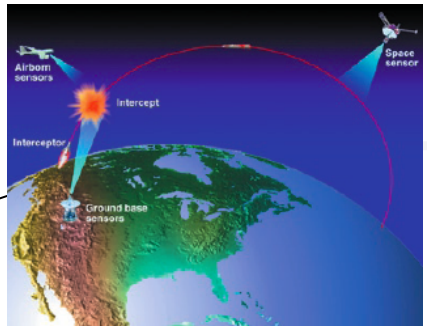
Simulation Based

NEXT GENERATION MANUFACTURING TECHNOLOGY INITIATIVE

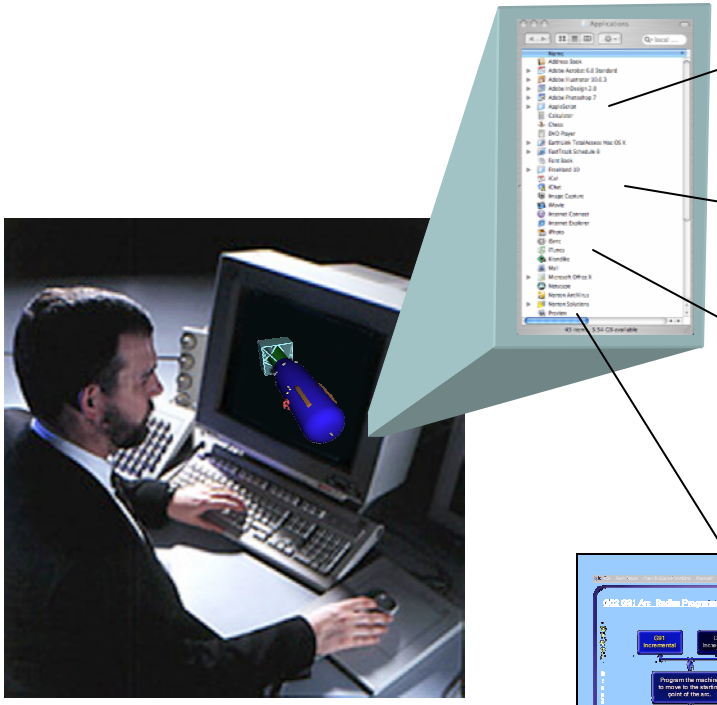


Science-based analysis supporting every aspect of the life cycle

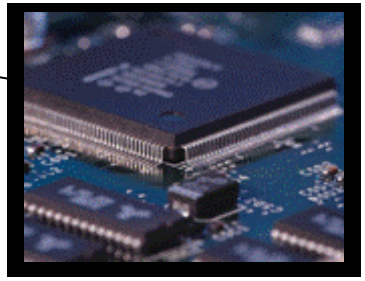
Instantly Responsive with . . .

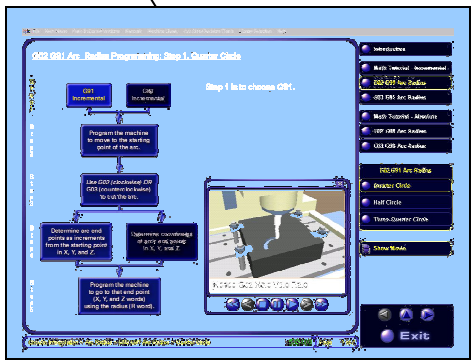


Requirements Analysis

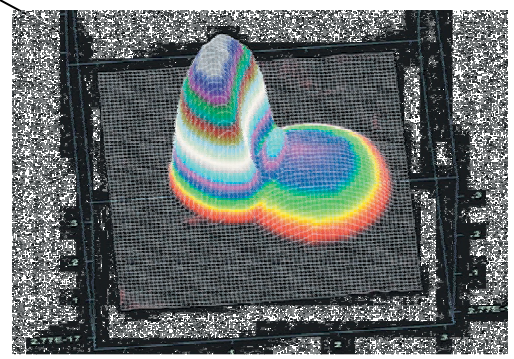


Performance Assessment





Producibility



Material Behavior

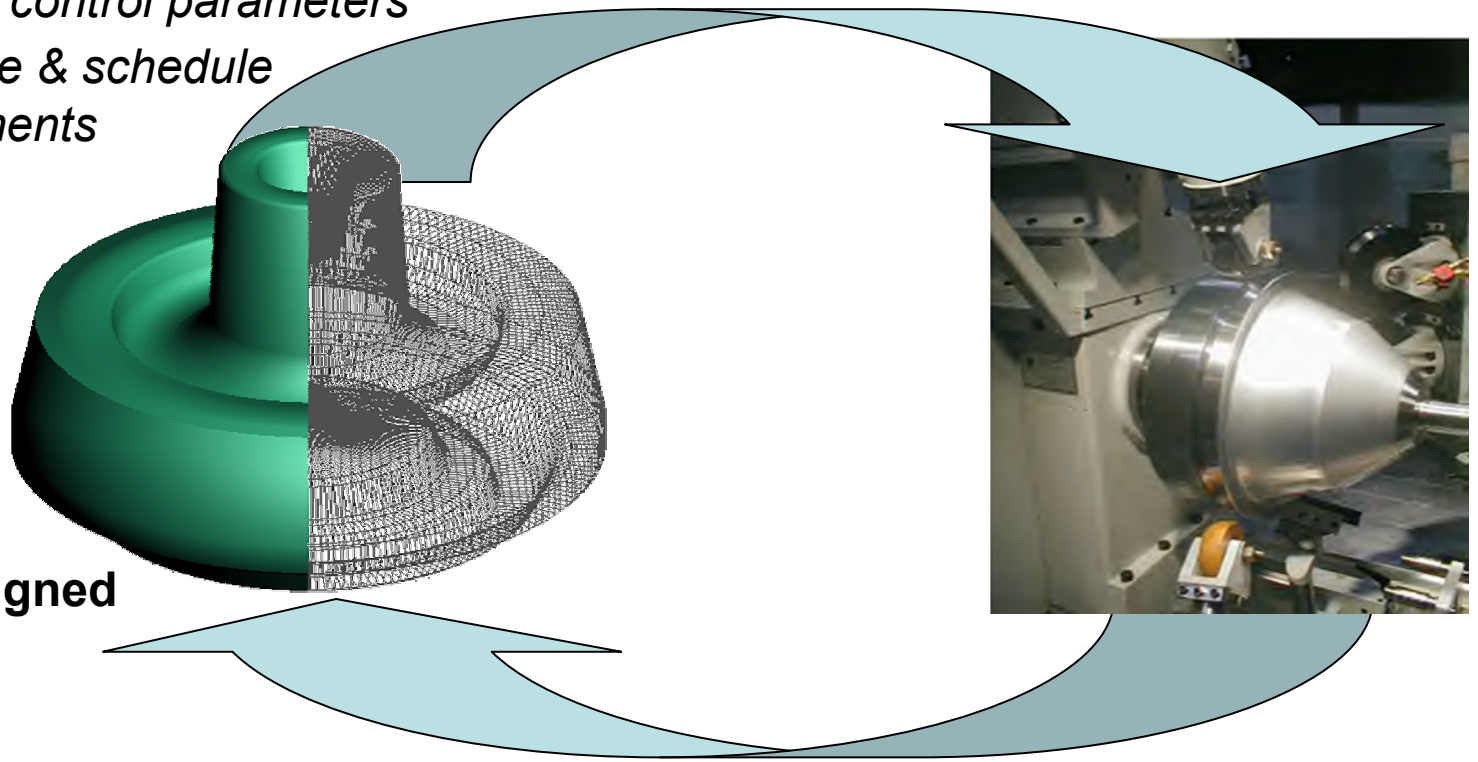
One-click access to all needed analysis capabilities

Capable of Supporting Closed-Loop Operation

NEXT GENERATION MANUFACTURING TECHNOLOGY INITIATIVE

- *Product & process definition*
- *Specs & control parameters*
- *Resource & schedule requirements*

As-Built



As-Designed

- *As-built configuration & properties*
- *Process performance & material behaviors*

Digital feedback deepens the knowledge base for future products

Bottom Line . . .

Validated Models

Validated designs

Validated Processes

In a totally managed enterprise

Validated Products

MBE Roadmap Process

- Define the current state of MBE capabilities
- Develop MBE vision
- Express vision, goals & requirements in strategic investment roadmap document
- Establish priorities
  - "Readiness, risk & return"
  - "Scope, magnitude, vital to US competitiveness"
- Prioritize with Kepner-Tregoe decision-making tool
- Write white papers on critical topics
- Review and validation by TAP
- Refine white papers

Narrowing MBE Focus

Roadmap contains 50 Goals w/ 247 Requirements

KT Analysis →

Top 20 Goals

Compilation of Important Themes →

15 White Paper Topics

- Previous Workshops
- Interviews
- Web-Based Search
- Literature

- Cross Cutting
- Topic Specific

- Product Realization
- Resource Management
- Strategic Management

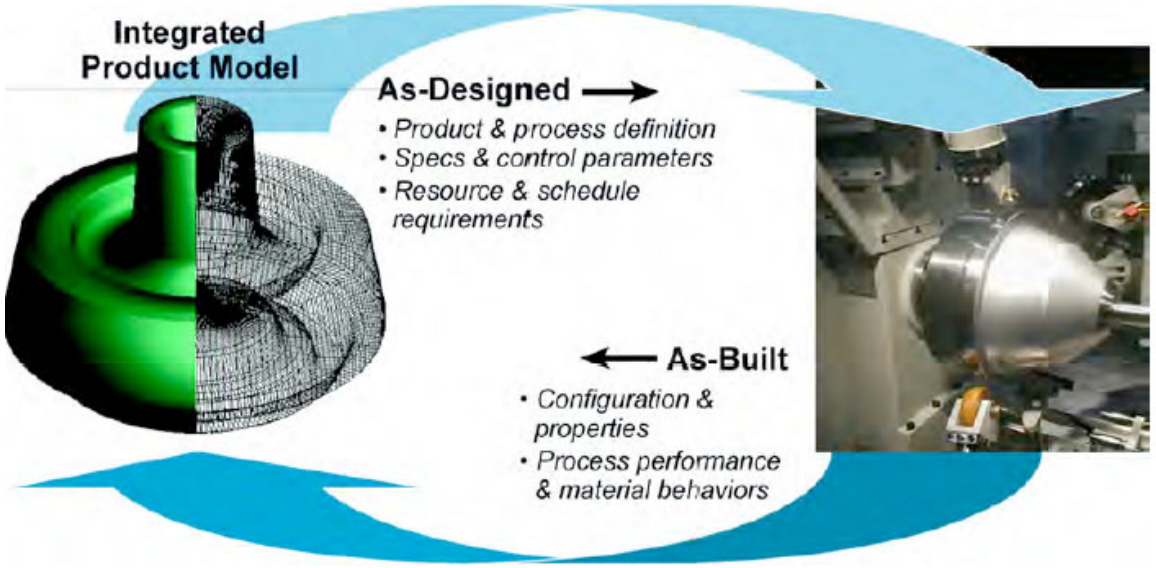
Project Roadmaps

TAP Review

12 Updated Topics

Configuration Management for the Model-Based Enterprise

Objective: **Develop an integrated system that assures association of the right information with any product or process throughout its life cycle.**

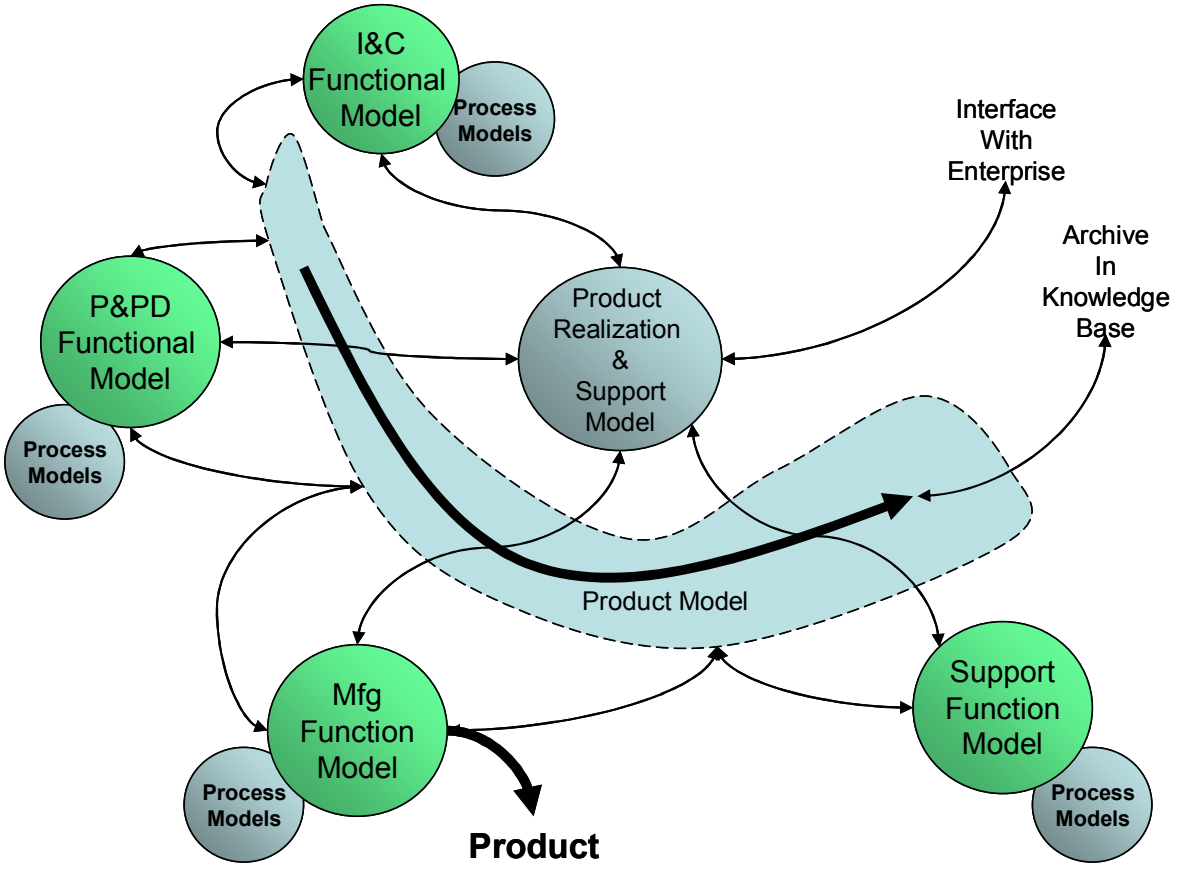


Benefits:

- Association of correct info with each version of each product or process in the enterprise
- Feedback loop, which enables continuous product improvement.
- Assured ability to reproduce

Flexible Representation of Complex Models

Objective: Develop capability to create collaborative models rich enough to support all MBE functions.



Benefits:

- Enables full evaluation of any decision
- Procurement cost savings in the billions of dollars
- Reduced time to market
- Reduced costs
- Better quality products

System-of-Systems Modeling for Model-Based Enterprises

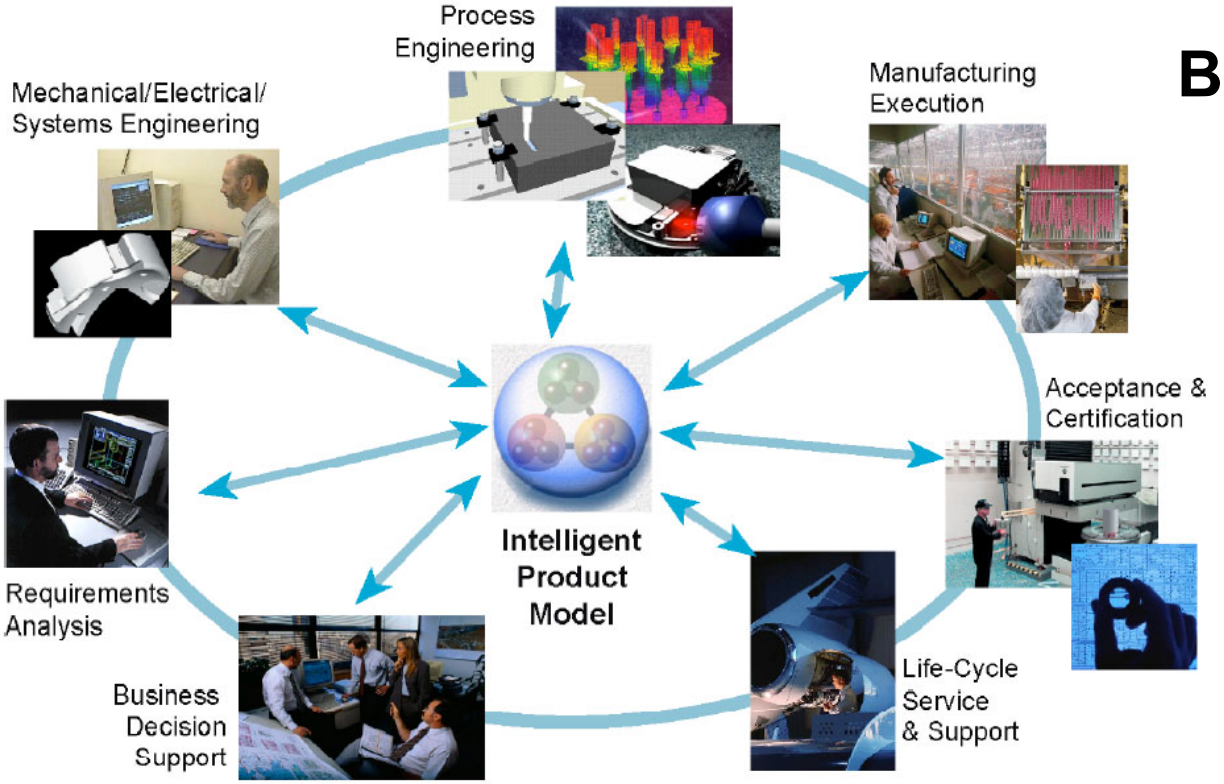
Objective: To develop capabilities, approaches, and tools for integrated multi-level, multi-system modeling of products, processes, and life-cycle functions.

Benefits:

- Composable and decomposable models enable evaluation of total system performance within its operational context
- Extends SoS philosophy to manufacturing enterprise
- Enhanced ability to simulate, with high fidelity, the effects of wear and tear on complex systems in combat and training

Intelligent Models for Manufacturing

Objective: Develop intelligent models that understand, seek out, acquire knowledge needed to execute their functions.

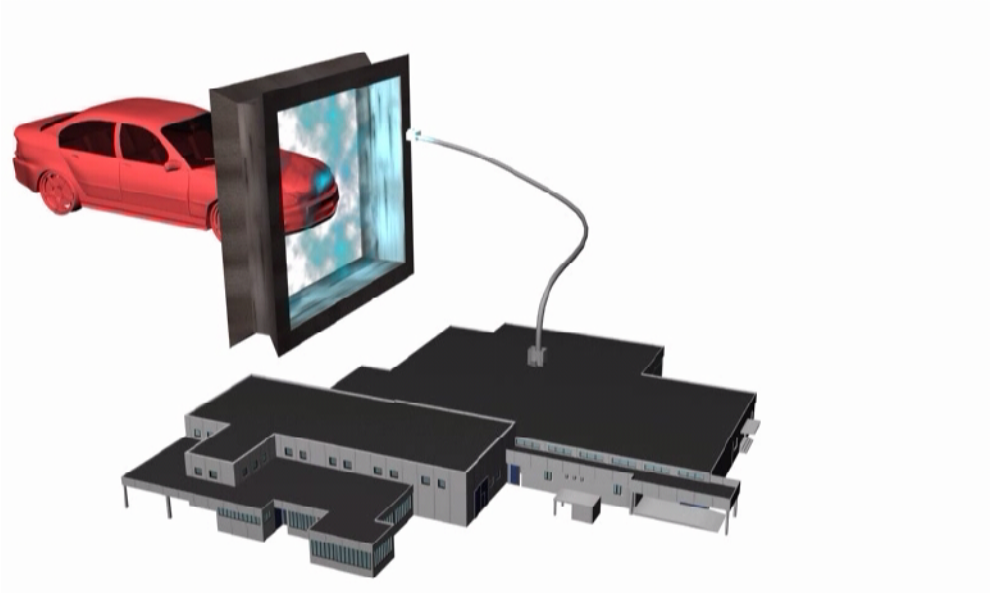


Benefits:

- Dramatic cost savings through elimination of design iterations
- Improved logistics support for weapons systems
- Significant reduction of design cycle times

Model-Driven Product and Process Development

Objective: **Develop simulation capabilities enabling the product model to fully support down stream operations.**

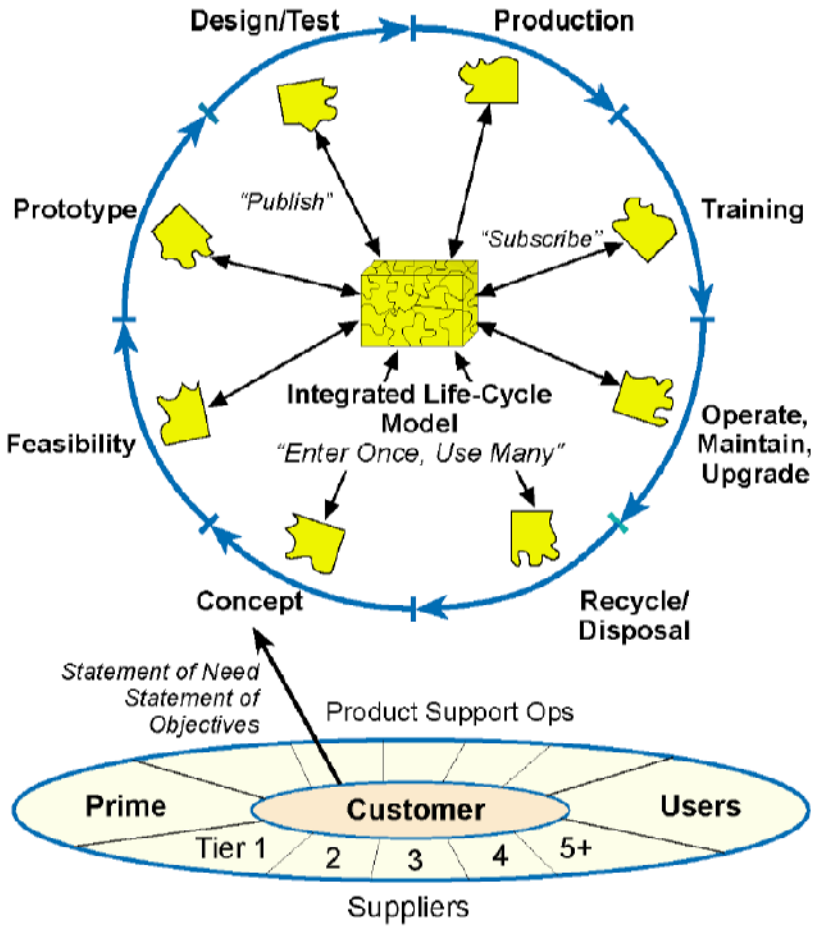


Benefits:

- Saves money and assures product quality
- Optimizes use of product and process capabilities
- Reduces the extent and level of design changes
- Enhances risk analysis and mitigation

Model-Based Product Life-Cycle Management

Objective: Provide the capability to create and apply hi-fidelity, scaleable product life-cycle models.

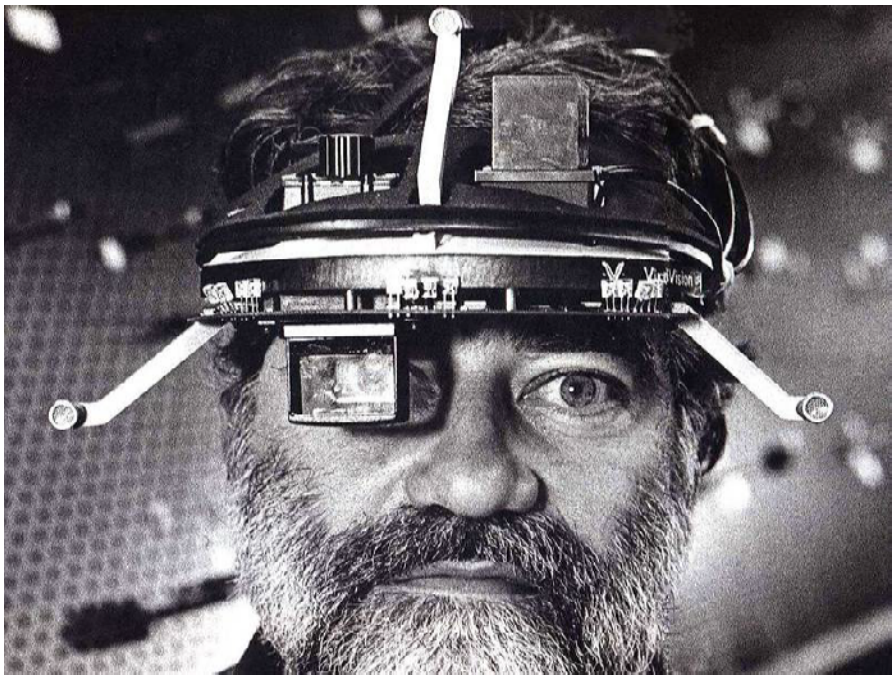


Benefits:

- Provides a toolset for modeling and understanding life-cycle cost and supportability impacts .
- Enables feed back from down-stream experience to improve up-stream functions.
- Improved speed and accuracy of technical and business decisions over the life cycle,
- Ability to analyze and reverse-engineer “as-worn” parts to predict failure

Information Delivery to Point of Use

Objective: Deliver information to any location in support of any enterprise function



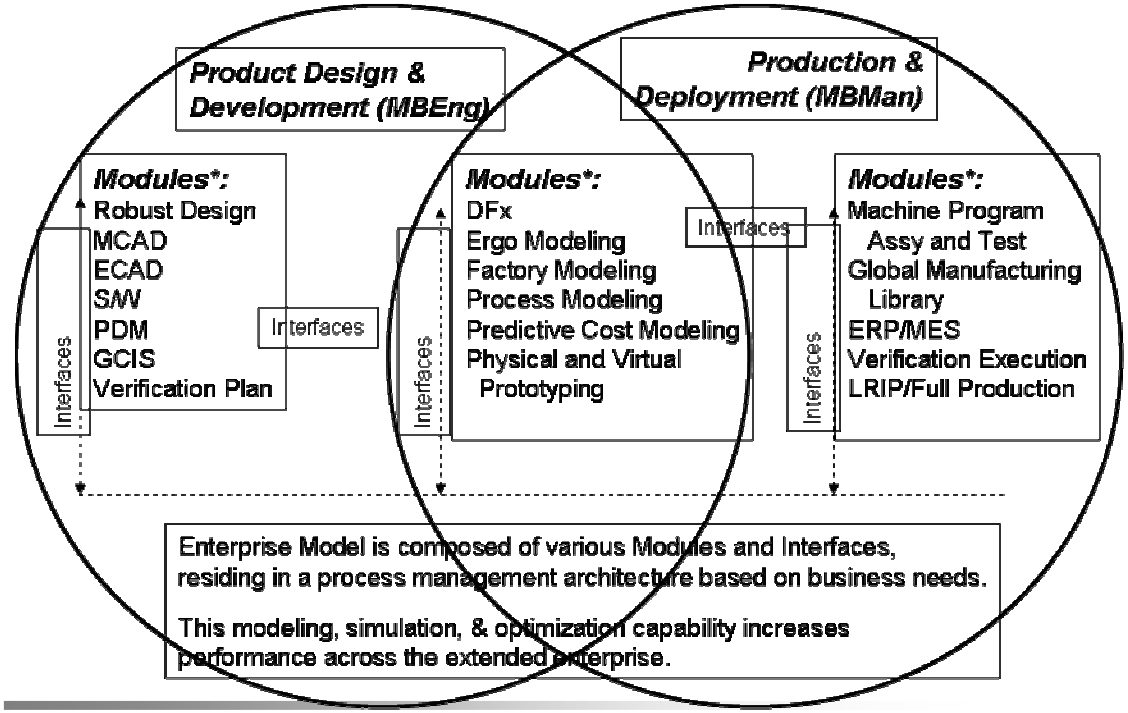
Benefits:

- Largely graphical information delivery
- Job compatible delivery
- Graphical format saves money in multi-lingual support
- Reduced warrantee cost for returns due to fewer mistakes

MBE Enablers for the Electro-Mechanical Industry

NEXT GENERATION MANUFACTURING TECHNOLOGY INITIATIVE

Objective: To apply product and process models to define and manage all enterprise processes, and by applying science-based analytical tools to make optimal decisions at every step of the product life-cycle.

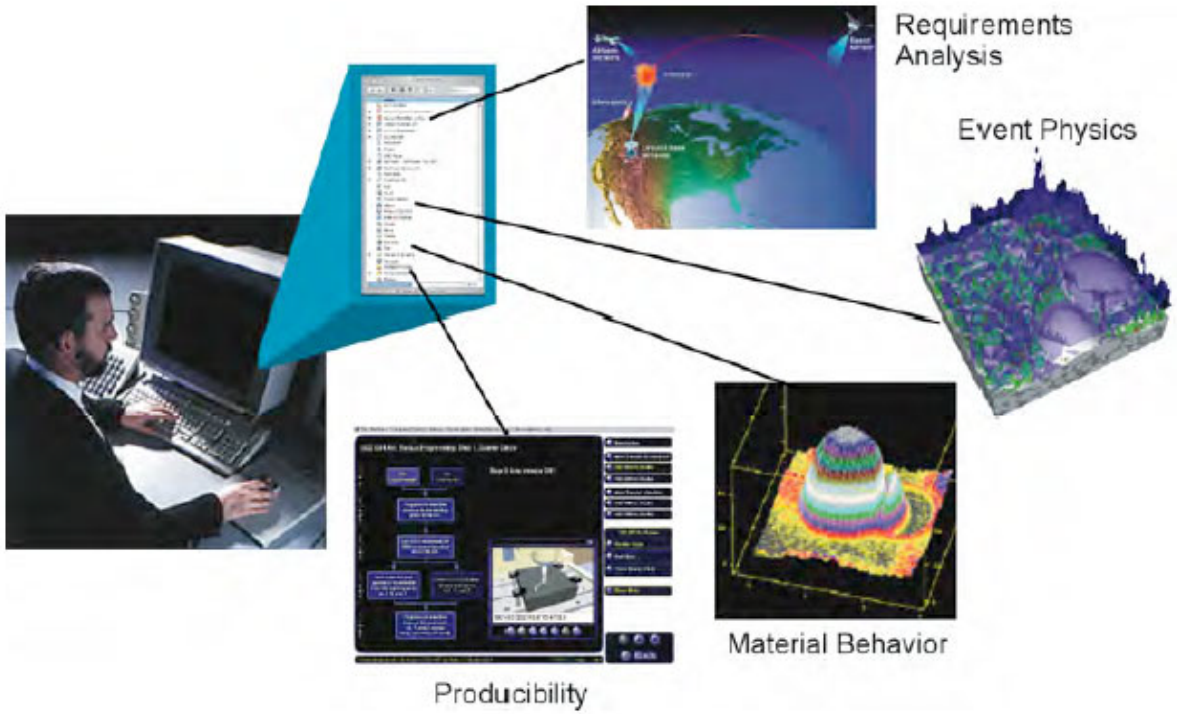


Benefits:

- **Model-Based testing offers development time savings of 50%**
- **Elimination of the "disconnect" between development and production**
- **Rapid response to customer demands**

Shared Model Libraries

Objective: Enable centralized access to modular components to support all MBE functions and optimize enterprise decisions

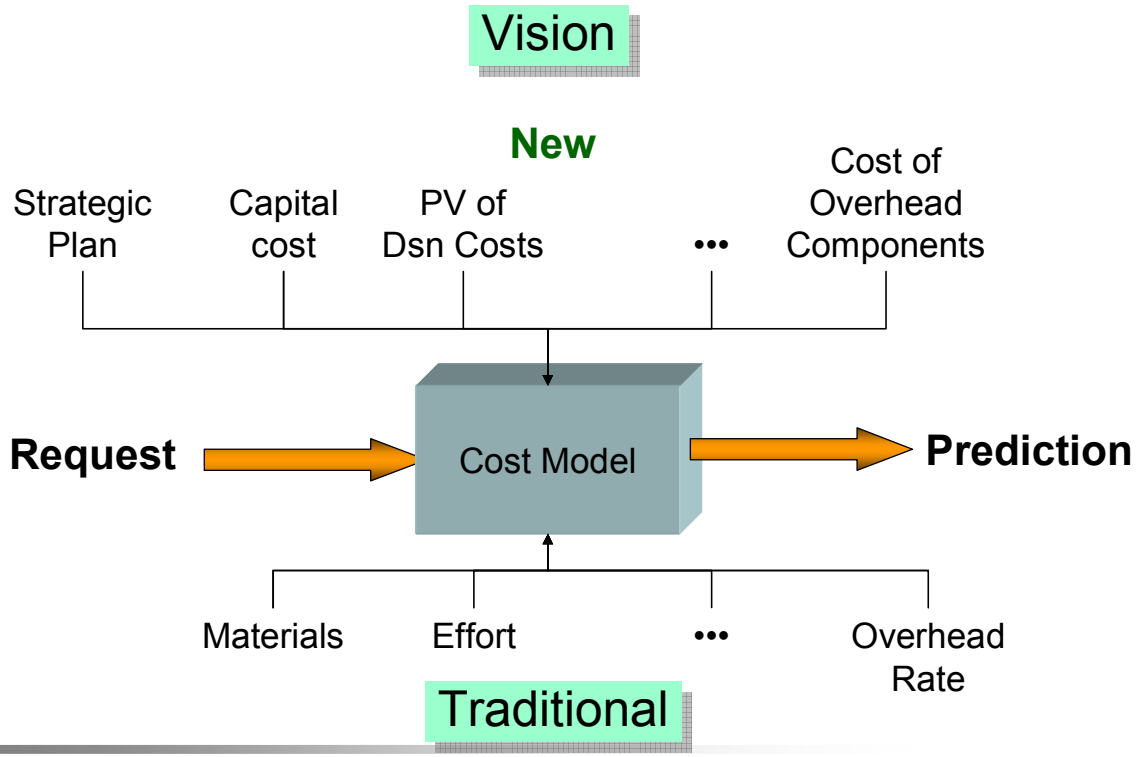


Benefits:

- Provides a core set of models affordable and available.
- Reduction in cycle time and cost by up to 40%
- Rapid integration and virtual testing of complex weapon systems
- Elimination/Reduction of redesign/rework costs and time

Enterprise-Wide Cost Modeling

Objective: Provide the ability to model and predict cost for every element and from every source in the enterprise, including uncertainty and risk.

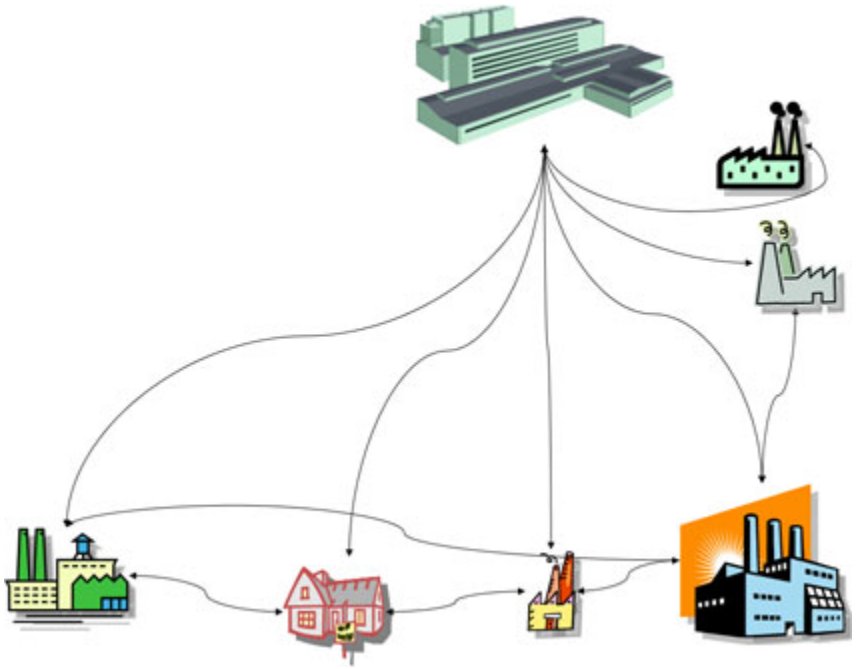


Benefits:

- Visibility of the cost impacts of design changes
- Eliminating low-ball estimates with directly traceable sources
- Significant areas of cost and expense can be easily identified
- Enables evaluation of Strategic options

Model-Based Real-Time Factory Operations

Objective: To develop enabling technologies for real time, model-based control of factory operations.

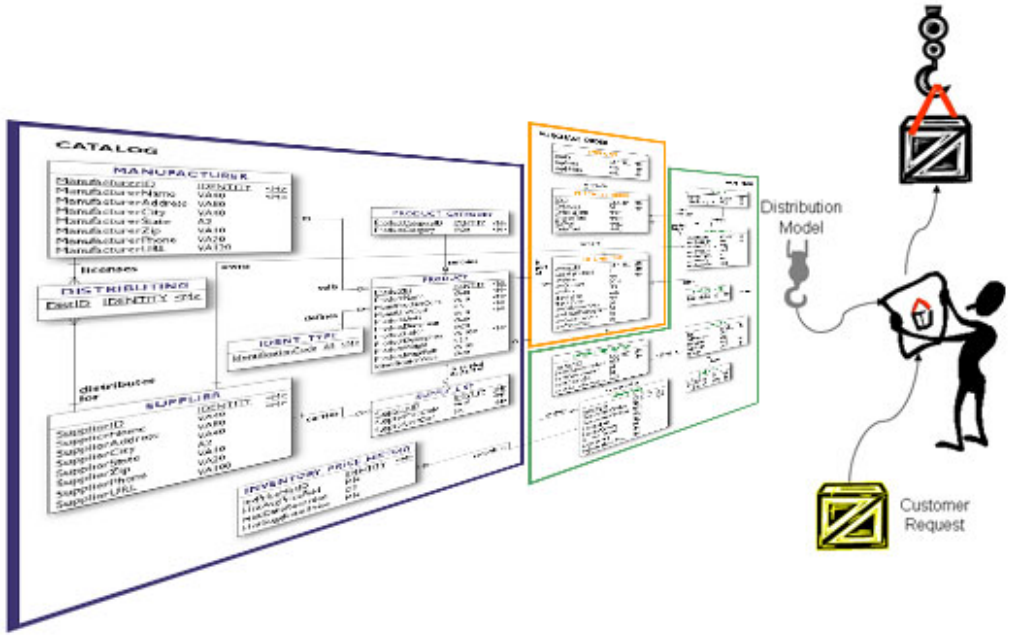


Benefits:

- First and every product correct due to process control.
- Maximum use of production capability
- More efficient, responsive, flexible, and capable manufacturing base
- Shortened timelines to ramp up production

Model-Based Distribution

Objective: **Provides a framework for supporting design for distribution planning, execution, and re-planning.**

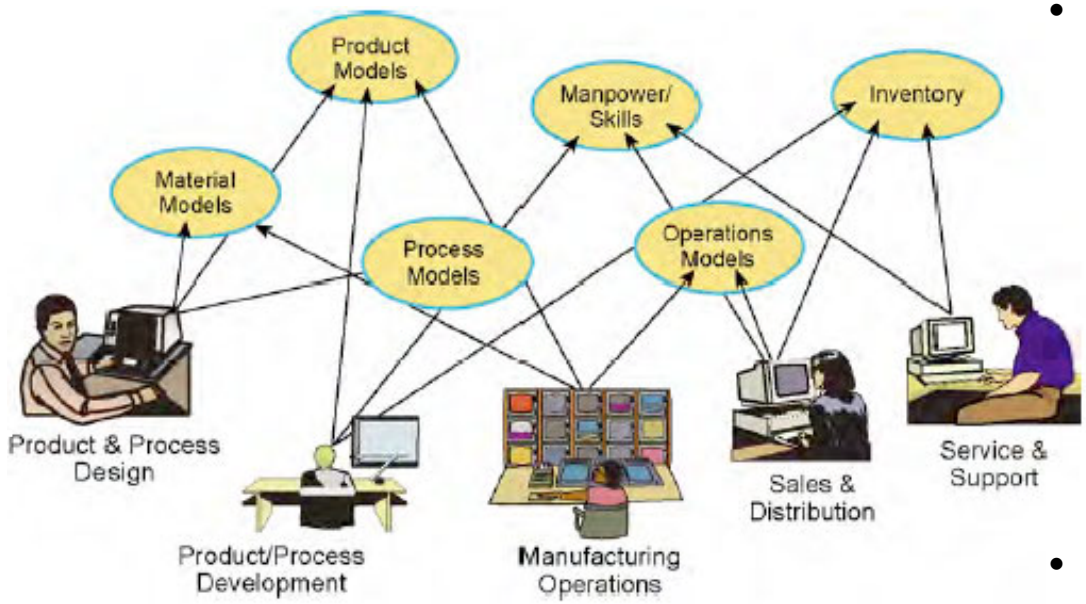


Benefits:

- "Engineer out" problems in new products rollout
- Accommodates far more variables in distribution planning
- Improved downstream life-cycle management
- Enables definitive information about where it should be
- Focuses for closing the loop on where it is

Model-Based Resource Management

Objective: **Create a cost effective, integrated capability for evaluating options and directing control over all manufacturing resources. Modular and easily integrated are key attributes.**

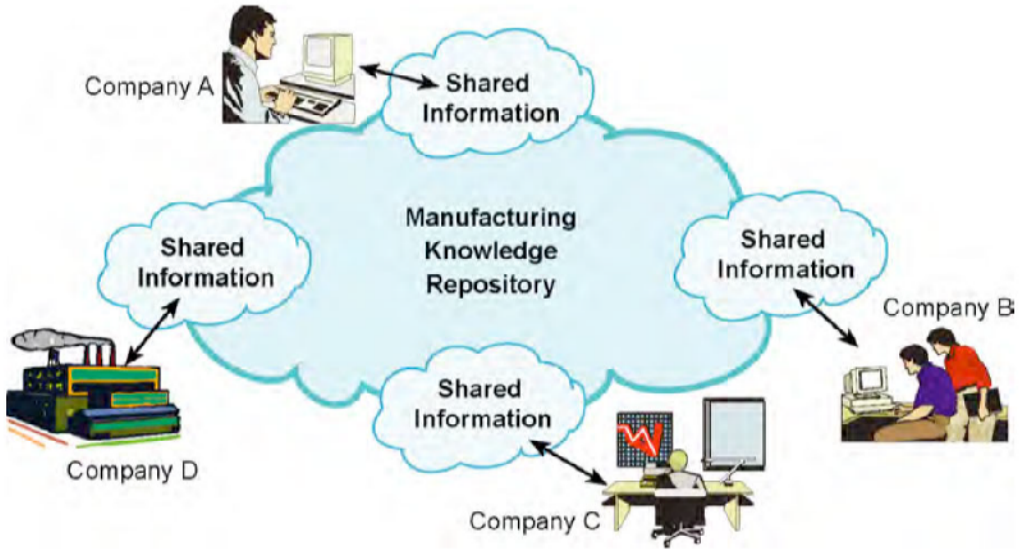


Benefits:

- Provision of model-based resource management capabilities that:
  - Greatly reduce the cost of acquiring, deploying and maintaining a resource management system
  - Enable far greater accuracy and efficiency in managing resources
- Enhanced ability of smaller suppliers to choose resource management tools, and to interface with prime manufacturers

Multi-Enterprise Collaboration

Objective: Provide a tool set to support multi-enterprise collaboration



Benefits:

- Mitigates the cost of transferring or recreating design definitions shared among different members of the supply chain.
- Enables ability to objectively evaluate potential suppliers
- Reduces contract administration costs by 50% through integrated reporting and management

Summary

- NGMTI is an important program to the nation
- We are off to a fast start and making great progress
- Project formation is in full swing – opportunity knocks

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