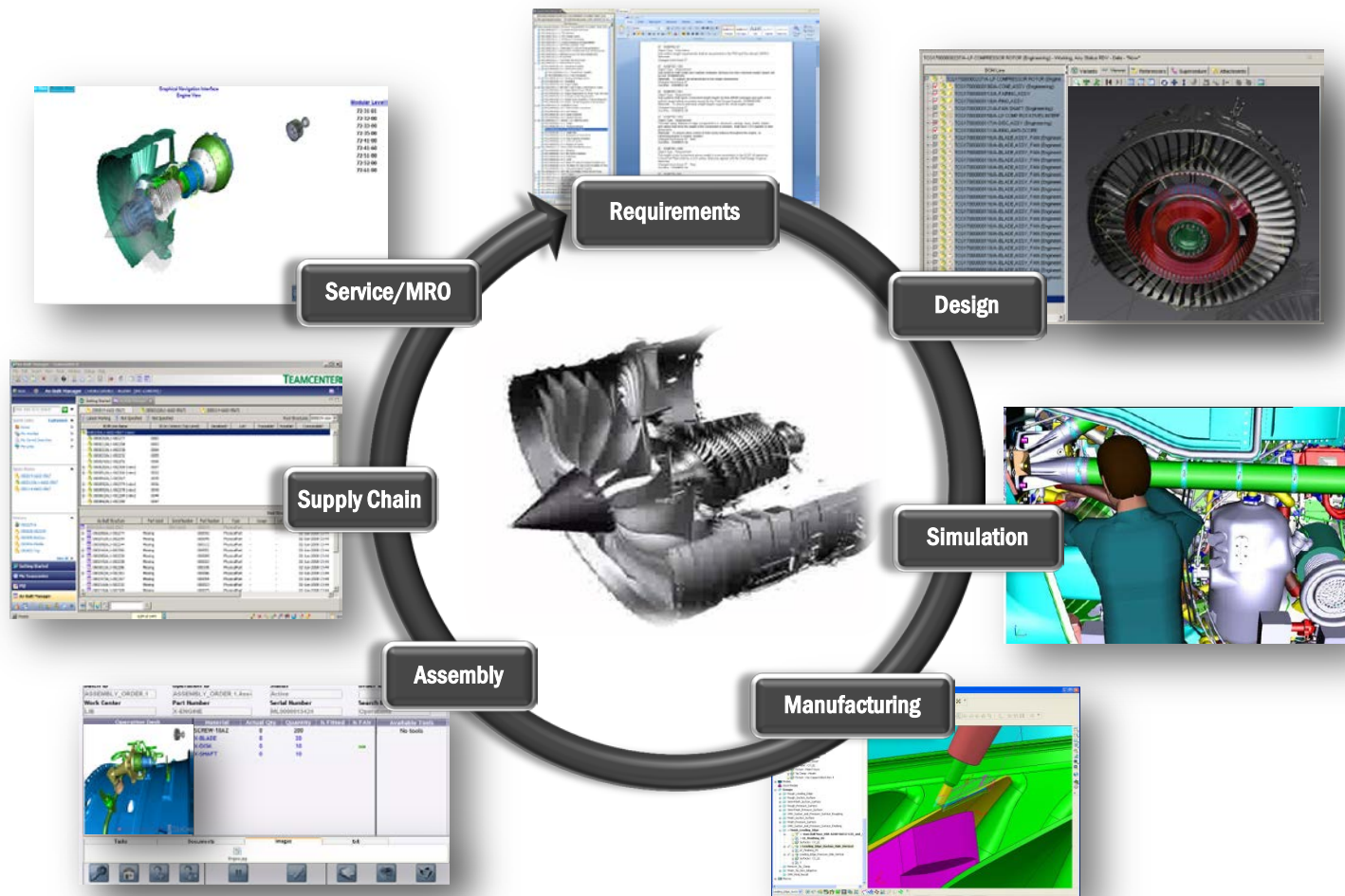




# **Purdue Product Lifecycle Management Center**

**Overview &  
Opportunities**



# CENTER OVERVIEW



# Mission

- The mission of Purdue University's Product Lifecycle Management (PLM) Center is to promote the advancement and implementation of PLM technologies and processes through research and education in partnership with industry.
- The objectives of the Purdue PLM Center are:
  - Establishing industry partnerships that guide, support, and validate PLM research and education activities;
  - Enabling PLM adoption and practice by industry;
  - Enabling collaboration between faculty, students, and industry partners to conduct research projects that attempt to advance PLM practice;
  - Assisting with the integration of PLM into academic curricula;
  - Facilitating the pursuit of PLM career opportunities by Purdue graduates;
  - Serving as a knowledge base and thought leader for the PLM discipline.



# Industrial Partners



**Sandia  
National  
Laboratories**



**TEXTRON**



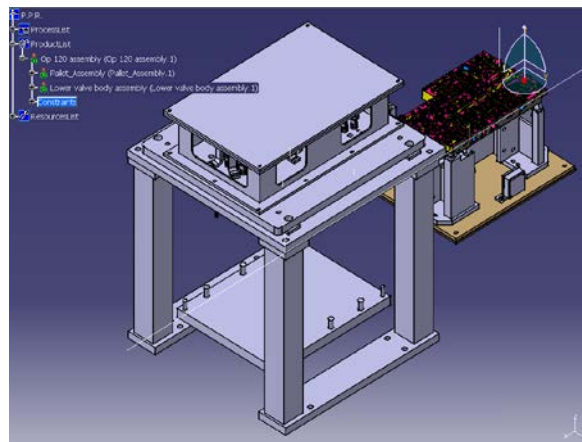
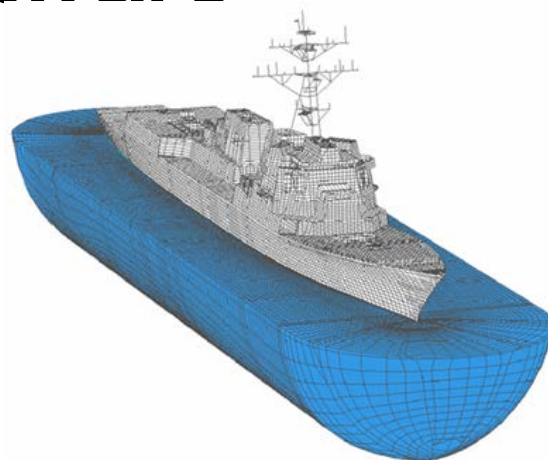
**Rolls-Royce**

**Gulfstream®**



# Resources – Software

- Purdue is an active participant in GM's Partners for the Advancement of Collaborative Engineering Education (PACE) program
- Purdue has the following PLM software tools installed and accessible by faculty and students.
  - Autodesk
    - *Inventor, Revit*
  - Dassault Systèmes
    - *CATIA, Solidworks*
  - PTC
    - *Creo, Windchill*
  - Siemens
    - *NX, Knowledge Fusion, Solidedge, TeamCenter, E-Factory, TC Community, TC Unified, Tecnomatix, Factory View, Jack, TC Visualization, TC Concept*
  - Fluent
    - *Fluent, Gambit, Icepak, Fieldview, Fidlap,*
  - LSTC
    - *LS Dyna*
  - MSC Software
    - *Nastran, Adams, Patran*
  - Altair Engineering
    - *Hypermesh, Optistruct, Motionview, Hypergraph*
  - Other
    - *JT, 3D PDF, Engineous I-sight, Abaqus, Ansys, Rhinoceros 3D, StudioMax, TecPlot, Kubotek, KeyCreator, Kubotek Spectrum, ITI CADIQ*



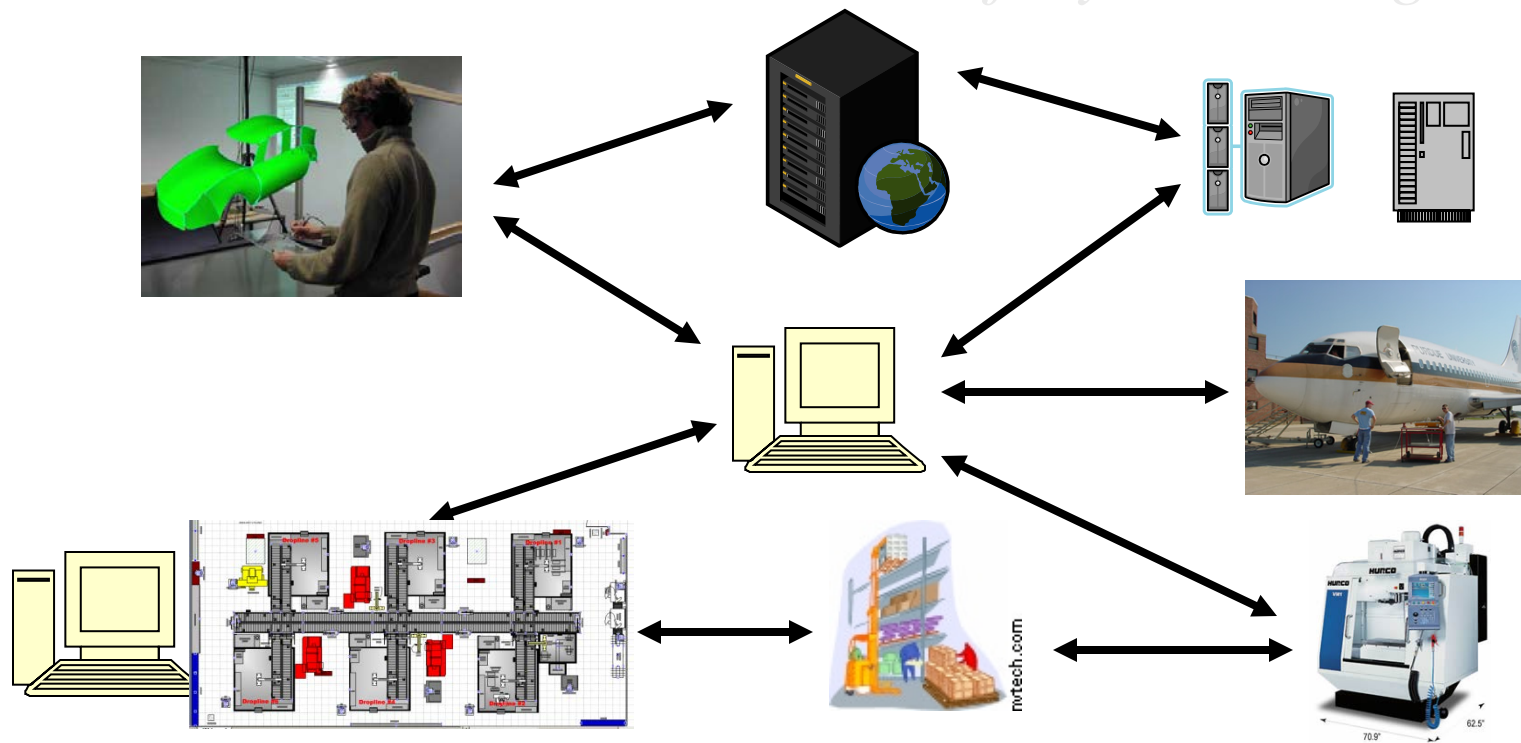


# Resources – Hardware

High level view:

- 6 Servers
- 12 CPUs
- 52 Physical Cores / 80 Logical Cores
- 200GB Memory
- 13TB Storage Capacity (2 external arrays plus direct attached storage)
- 30 Server Gigabit ports, all gigabit networking for PLM server to clients.

Server	CPUs	Physical Cores	Logical Cores	RAM (GB)	Storage (TB)	Networking ports	Misc
Dell PowerEdge R710	2	12	24	96	8	8	7.75TB in external arrays, 0.25 local
HP Proliant DL380 G7	2	8	16	24	1.33	8	
Dell PowerEdge T710	2	8	16	32	1.2	8	
Dell PowerEdge 2900	2	8	8	16	1	2	
Dell PowerEdge 2900	2	8	8	16	1.25	2	
Dell PowerEdge 2900	2	8	8	16	0.25	2	



# RESEARCH PROGRAM



# Research Projects – Overview

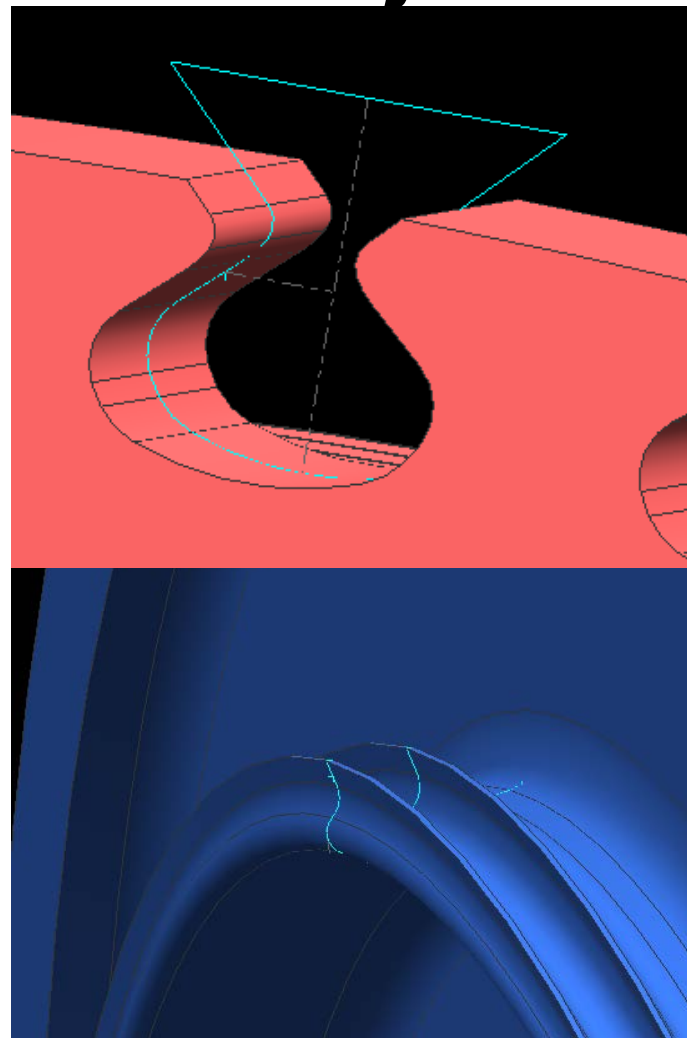
- Process Overview:
  - Topics generated by IAB members at spring (~April) IAB meeting
  - Request for proposals sent to faculty at start of fall semester
  - IAB selects winning proposals (3 – 5 per year) at fall (~October) IAB meeting
  - Performance period is following calendar year
    - *Project status update at spring IAB meeting*
    - *Final report presentation at fall IAB meeting*
- 30 seed grants awarded since 2005
  - Average award \$30,000, typically funding one ½-time graduate research assistant
  - Breakdown by college:
    - *College of Technology: 17.5 awards*
    - *College of Engineering: 9 awards*
    - *College of Science: 3.5 awards*





# Sample Research Projects

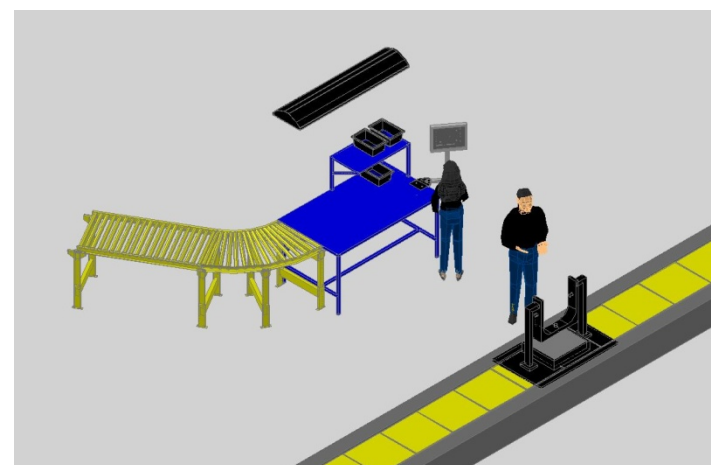
- **Data Management:**
  - **PDM Investigation, Evaluation, Implementation, and Demonstration for PLM –**  
*Dr. Craig Miller (Computer Graphics Technology)*
  - **Exploratory Research in Database Systems Support for Product Lifecycle Management –** *Dr. Walid Aref (Computer Science)*
- **Visualization:**
  - **Cutting Edge Visualization for Product Lifecycle Management –**  
*Dr. Voicu Popescu and Dr. Chris Hoffmann (Computer Science)*
  - **Creation of Design Spaces and Exploration Through Visualization and Configuration –**  
*Dr. Karthik Ramani (Mechanical Engineering)*
  - **PLM Visualization on Mobile Devices –**  
*Dr. Voicu Popescu (Computer Science) and Dr. Nate Hartman (Computer Graphics Technology)*





# Sample Research Projects

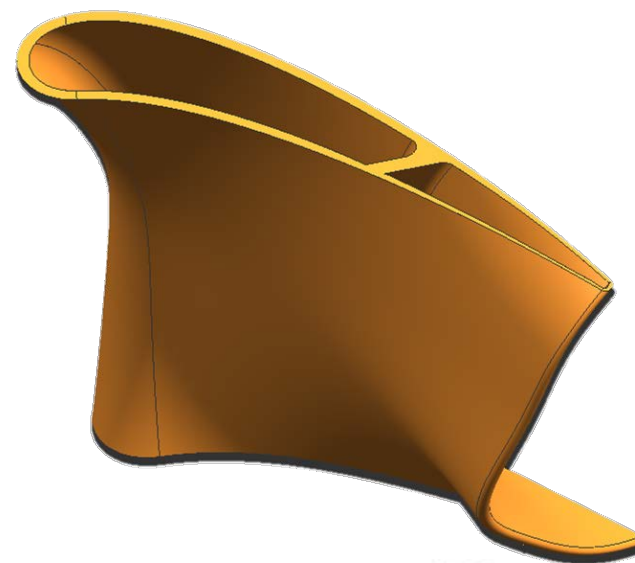
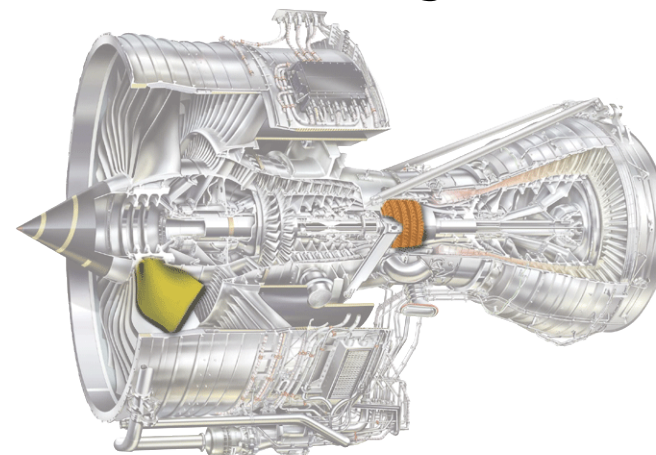
- **Design:**
  - **Configuration Driven Design for Knowledge Re-use During Product Lifecycle –**  
*Dr. Karthik Ramani (Mechanical Engineering)*
  - **Next Generation DHM for Assessing Short Duration Events in Work Analysis & Design –** *Dr. Vince Duffy (Industrial Engineering)*
  - **A Procedure of Analysis of Feasibility and Uncertainty in Distributed Product Development Environments –**  
*Dr. Ganesh Subbarayan (Mechanical Engineering)*
- **Education:**
  - **PLM Cross Functional Certification and Training: Efficacy and Competency Profile –**  
*Dr. Darrel Sandall and Dr. Abe Walton (Organizational Leadership and Supervision)*
  - **PLM Collaboration Training Using Advanced Distance Learning Strategies –**  
*Dr. Edie Schmidt (Industrial Technology)*





# Sample Research Projects

- **Operations / Processes:**
  - **PLM Metrics, Phase I, II, and III –**  
*Dr. Cynthia Tomovic (Organizational Leadership and Supervision)*
  - **Models to Support Auto-ID Based Process Control Systems in PLM –**  
*Dr. Edie Schmidt (Industrial Technology)*
  - **Integrated Sensing and Diagnostics for Product Life Cycle Health Management of Gas Turbine Engines : Application to Wire Harnesses and Connectors –**  
*Dr. Doug Adams (Mechanical Engineering)*
- **Sustainability:**
  - **Product Lifecycle Management: Roadmap to Global Sustainability –**  
*Dr. Scott Homan (Organizational Leadership and Supervision)*
  - **Energy and Sustainability Models in PLM –**  
*Dr. Karthik Ramani (Mechanical Engineering)*





# Current Research Projects

- 1. Implementing ontology-based information sharing in Product Lifecycle Management –**  
*Dr. John Springer (Computer & Information Technology)*
- 2. Value Characterization across the Product Lifecycle to Support Green PLM and New Business Creation –** *Dr. John Sutherland (Environmental and Ecological Engineering) and Dr. Larry Nies (Civil Engineering)*
- 3. Integration of PLM and ERP for BOM management –** *Dr. Edie Schmidt (Industrial Technology) and Dr. Hank Kraebber (Mechanical Engineering Technology)*
- 4. Cutting Edge Visualization for Product Lifecycle Management –** *Dr. Voicu Popescu (Computer Science)*
- 5. Examining the Use of Lightweight 3D Formats on Handheld Devices -** *Dr. Nathan Hartman (Computer Graphics Technology)*



# Proprietary Projects

- PLM Center Director and staff can assist IAB members and other companies interested in sponsoring research projects. These projects provide several benefits to industry sponsors:
  - Ability to meet company specific needs
  - Companies often recruit and hire graduate student research assistants
  - Greater insights into faculty research areas and future collaboration possibilities
  - Include non-disclosure agreements
  - Intellectual property agreements



# Seed Grant Leverage

- Historically, the PLM Center seed grants created a virtuous cycle, by enhancing the ability of faculty investigators to receive additional research funding
  - **\$274,000** from SME for the development of Curriculum Modules in PLM.
  - **\$1,500,000** from NSF-ATE to create and coordinate PLM education in leading Midwest community colleges.
  - Dr. Elisha Sacks - **\$600,000** from NSF.
  - Dr. Nathan Hartman - **\$35,000** from NIST.
  - Dr. Nathan Hartman – over **\$750,000** from Rolls Royce
  - Dr. Karthik Ramani – over **\$500,000** from NSF



# EDUCATION

PLM



# PLM Curriculum

- 3D Modeling
- Analysis and simulation
- Product data management
- Product lifecycle management
- Virtual collaboration
- Standards/interoperability
- Web development/front-end & back-end infrastructure
- Machine-tool manufacturing
- Additive manufacturing
- Manufacturing process planning
- Quality management/LEAN
- Supply-chain modeling and development
- Maintenance/MRO
- Sustainability





# PLM Curriculum – Next Generation

## Product and Process Systems Integration

- A focus on the product lifecycle
- Use of the model-based definition as a metaphor throughout the curriculum
- Placing emphasis on product support, supply chain and production early in the curriculum
- Core courses that each student will take
- Flexibility to provide a balance of breadth and depth

# Product and Process Systems Integration

Common core 80% of each respective course in each blue box; 5% each of the other four courses

## Common Core

Product and Process System Sustainment

Supply Chain and PLM

Production Systems and PLM

Systems Development

Model-based Enterprise and PLM

Project-based Capstone Course

## Technical Depth

System operations components

Enterprise elements

Production processes

System requirements

Modeling

Work instructions

Distribution/logistics

Production planning and control

Process mapping

Interoperability/Standards

QMS/RMS/risk analysis

Purchasing/procurement

MRP/ERP/Lean/Quality

Testing/validation/verification

Data management

Repair/overhaul/recycling

Inventory management

Automation/controls

Systems development/simulation

Simulation/visualization

One full vertical plus 2/4 from three others



# PLM Certificate Program

- Initially conceived and developed with The Boeing Company. Other companies now participating.
- Three 8-week classes covering model-based definition, product data and configuration management and digital manufacturing.
- Additional courses planned to cover collaboration and interoperability, supply chain and PLM, and maintenance and repair and PLM
- 2 hour lecture via Adobe Connect and 2 hour virtual lab each week.
- Offered through the Purdue Continuing Education Program.
- <http://www2.tech.purdue.edu/centers/plm/index.html>
- Two cohorts of students have completed the program





# MEMBERSHIP

PLM



# Industrial Partners Membership

- Membership - \$50,000 per year
- List of benefits outlined on the following slide
- Intellectual Property Agreement
  - General PLM Center of Excellence agreement signed by all members
  - Specific IP agreements for company projects when appropriate and required



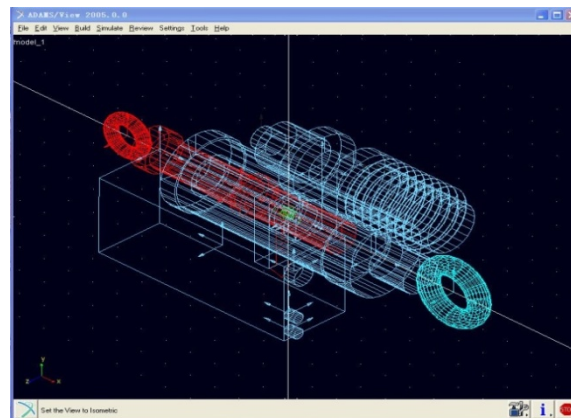
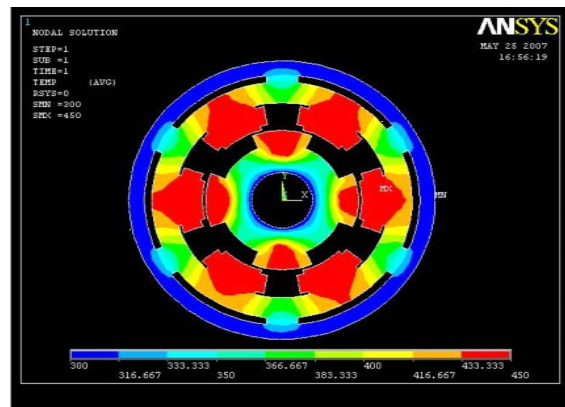
# Potential Member Benefits

- Opportunity for Collaboration / Discussion with other IAB Members to Gain Input and Feedback from their Expertise
- Contribute to Definition of Research Project Topics and Vote for those to receive Funding
- Obtain Early Access to Research Results, Including Publications and White Papers
- Short Course from the research Project results
- The opportunity to propose other projects to be funded independent of the Seed Grants
- Engage in PLM Benchmarking / Roadmapping Activities with Purdue PLM-related faculty as appropriate
- On-site Faculty Presentation / Seminar
- The opportunity to propose Capstone / Independent Study Projects in appropriate departments
- Student Recruitment
- Attend Annual Conferences, Seminars, Training Forums, Demonstrations of Latest Technologies and Participate in Panel Discussion being held at Purdue in PLM-related areas
- Guest Lectures for Classes in order to share expertise, increase company recognition among Purdue students having interests in PLM careers, and build ties to Purdue faculty



## PLM Center History

- Interdisciplinary Research Effort:  
Technology, Engineering, Science,
- Started with 750K 3-year Purdue commitment
- Center Membership:
  - Cummins Engine Company
  - Rolls Royce
  - General Motors
  - The Boeing Company
  - Sandia National Laboratory
  - Gulfstream Aerospace Company
  - Textron
- Other Support:
  - Procter & Gamble
  - Eli Lilly
  - PACE Program
  - HP/EDS
  - Chrysler
  - Siemens PLM
  - PTC
  - Dassault Systemes





# Contact

To join the Center or for more information on PLM related activities at Purdue, please contact:

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Director, Purdue University PLM Center

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(m) 1 765 412 3054

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