CAx Education in WSU Industrial and Manufacturing Engineering

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Agenda

- Introduction to WSU IME department
- Existing courses and lessons learned
- Opportunities
- Vision
Department of Industrial and Manufacturing Engineering (IME)

- Committed to the delivery of high quality education and industry-relevant research
- Nationally recognized in a broad range of areas
  - Operations research, quality engineering, product development, supply chain management, ergonomics, engineering management
- Three specialized M.S. degrees and Ph. D. degree
  - 1) Industrial Engineering (with concentration in Enterprise Integration, Quality Management, Operation Management, and Manufacturing Systems)
  - 2) Manufacturing Engineering (with a focus on Computer Integrated Manufacturing, and Quality)
  - and 3) Engineering Management.
- Efforts to translate this leadership in graduate education into the undergraduate IE program
Production Management Leadership Program (PMLP)

- An industrial academic partnership with General Motors, Chrysler, Ford, and Visteon
- Designed to address the continuing need for technically trained, first-line production management supervisors in manufacturing organizations.
- Leverages a blend of cross-disciplinary and newly designed courses with sponsored internships and job placement
- Student’s opportunities
  - Scholarships up to $5,000 per year
  - Travel within the U.S. and abroad to visit manufacturing facilities
    - NUMMI plant of United Motors (GM-Toyota), Silao Assembly - Mexico, Germany
  - Paid summer internships (Local and national plants)
  - First line supervisory experience
- Recently, changed to Operations Management Leadership Program (OMLP)
Additional Facts

- More than 31% of our students have honor point averages above 3.3
- Over 95% of our students obtain jobs within one year post-graduation
- The student chapter of IIE took 1st and 2nd place at the 2008 IIE Regional Conference paper competition
- The department works to offer internships and co-op opportunities to a significant portion of our UG students (approx. 35%)
Existing Courses and Lessons Learned

- CAD/CAM (IE6420)
- Facilities Planning (IE4330)
CAD/CAM (IE 6420)

- Winter Semester, 4 credit graduate course
- Major change required for the previous course
- Topics
  - Engineering product specification
  - Engineering drawing and orthographic projection
  - Part modeling
  - Solid and feature based design
  - Geometric tolerancing
  - Geometric modeling
  - Process engineering
  - Tooling and fixturing
  - Numerical control programming
  - Prototyping
  - Product lifecycle management
- Term Project
  - Smart Mobile Device Design and Manufacturing
- Software tools
  - NX 4 including CAM
Integrated Product Development (IE6405) & Alternative Energy Product Realization System (AET5600)

- Winter Semester, 4 credit graduate course

Course objectives
- Develop the competence with a set of tools and methods for product design and development.
- Understand the processes involved in creating a new product or modifying an existing product.
- Awareness of the role of multiple functions in creating a new product (e.g., marketing, finance, industrial design, engineering, production).
- Awareness of the importance of system, process, and information integration in product development.
- Develop the ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective of launching a new product.

Term project
- Innovative engineered system and alternative energy system development

Potential tools
- NX and Teamcenter Engineering
Facilities Planning (IE4330)

- Winter semester, 3 credit undergraduate core course
- Design of manufacturing, warehouse, and material handling facilities. Use of analytic and computer-aided methods in the facilities design process.
- Facility layout and design project
- eFactory
- Tecnomatix
Lessons Learned

- Not integrated courses
- Limited time to cover modern issues
- Student’s motivation to use modern tools (especially UG)
- Often too broad subjects to cover

- Positive experience from realistic project
  - Realized the significance of effective use of computer aided manufacturing technologies (from CAD/CAM student teams’ reports)
    - “Even the parts can be designed individually, which is a relatively easy task, it is difficult to design the part that match perfectly during assembly. When design the assemble it should be practical as well as should not have any interference with the other parts.”
    - “When design a part it must have dimension that can be practical. For example, the outside wall thickness of the main base can be theoretically design for 1/64 in. It may be even manufacturable, depending on the material used. However it is too thin and does not have required strength to contain the other parts.”
    - “…, the shape can be conceptualized easily, but creating such shape in the CAD is quiet challenging. It was easy to use CSG rather than surface modeling which need more understanding and experience.”
Opportunities

- NSF CCLI II project
  - Collaborative research: a flexible adaptation framework for implementing ‘learning factory’ – based manufacturing education

- PACE
  - PACE infrastructure
  - Global manufacturing engineering in the PACE emerging market vehicle collaboration project
Global manufacturing engineering in the PACE emerging market vehicle collaboration project

- Begun in the 2007-08 academic year
- Collaborative and global project to collaboratively create a vehicle, from design to manufacturing, as the best that it can be, mirroring the automotive development process.
- Exercise of modern design, manufacturing, assembly technologies
- Integrated with the design and engineering phases
- WSU contributes to General Assembly issues
Vision of WSU-IME UG CAx Curriculum Innovation

- UG CAx education
- Formative and summative assessment tools for integrated CAx curriculum
- Product realization concentration (12-16 credits in BSIE)

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<tr>
<th>Current IME</th>
<th>Current ET</th>
<th>Future IME</th>
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<tbody>
<tr>
<td>▪ Materials Science for Engineering Applications (BE 1300/1310)</td>
<td>▪ Manufacturing Processes (MIT 3510)</td>
<td>▪ MANUFACTURING FUNDAMENTALS</td>
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<tr>
<td>▪ CAM (IE 4410)</td>
<td>▪ Process Engineering (MIT 3600)</td>
<td>▪ Manufacturing Processes + Lab (IE 3450 + IE 3455 lab)</td>
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<td>▪ Concurrent Engineering Design (IE 4450)</td>
<td>▪ Computer-Aided Design and Manufacturing (MIT 4700)</td>
<td>▪ PRODUCT REALIZATION CONCENTRATION</td>
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<td>▪ (3-4 course sequence, total 12-16 credits)</td>
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## Product Realization Concentration

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<tr>
<th>Topic</th>
<th>Description</th>
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<tr>
<td>Computer-aided Drafting</td>
<td>Including Engineering drawing and 2D design (AutoCAD)</td>
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<tr>
<td>Computer Graphics</td>
<td>Including coordinate systems and transformation, visualization, surface modeling, geometric modeling, etc.</td>
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<tr>
<td>CAD</td>
<td>Including 3D modeling and viewing, modeling aids and tools, solid modeling, parametric design, feature-based design, and assembly modeling</td>
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<tr>
<td>CAD/CAM</td>
<td>Including process planning (CAPP), NC part programming, programmable logic controller, etc.</td>
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<td>Product Lifecycle Management (PLM)</td>
<td>Including CAD integration, Product Data Management (PDM), product data exchange, collaborative and concurrent design, etc.</td>
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<tr>
<td>Integrated Product Development (IPD)</td>
<td>Including product development processes and organizations, product planning, product specification, product architecture, DFX, PD project management, etc.</td>
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Thank you!

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