Rapid Product Innovation  
IEMS 497 Section 05  
Living Syllabus (version 3.0), 1/21/07  
MMM Mini Course Offering  
Spring 2007, First Five Weeks of Quarter  
Tuesdays (3/27, 4/3, 4/10, 4/17) 3:15 – 6:00 p.m., Ford Building ITW Class Room (#1-350) and all day (0600 to 1600) Wednesday 4/25, Road Trip to Johnson Controls, Holland Michigan Facility  
Blackboard URL: http://courses.northwestern.edu/webapps/portal/frameset.jsp?tab=courses&url=/bin/common/course.pl?course_id=_160829_1

Course Description: In order to sustain and grow market share in contemporary manufacturing industries, firms continually seek to innovate and develop new products and processes. Central to this quest is the timely and efficient prototyping, testing, and pilot production of physical products. Computer Aided Engineering technologies are the enabling tools that substantially reduce development cycle time and cost. This short course will give an in depth review of how these technologies are used in a contemporary manufacturing enterprise. Industry specific application and management of these technologies will be addressed through case studies in Automobile product development (BMW), Defense industry product development (Boeing), America's Cup Yacht Race Engineering (Team NZ), and consumer durable power equipment engineering (Ryobi Engines).

Special Addition 2007 Offering: In past offerings of this course, students enjoyed a visit to the Johnson Controls Prince Innovation Center (automotive interiors), a facility that employs state of the art prototyping processes and methodologies. This year we are planning a similar outing, tentatively scheduled for Wednesday April 25, 2007. Additionally, we are introducing some material examining the operations of a remarkable firm in the rapid product realization business, INCS of Japan. The architect/entrepreneur behind the success of Japan' INCS, Mr. Yamada, will be visiting our class to present on 4/10 (tentative).

Instructor: James G. Conley, Professor, Kellogg School of Management, Professor of Industrial Engineering and Management Science. Office: Jacob Center 5249, x1-4814, Office hours by appointment e-mail: j-conleya@kellogg.northwestern.edu.

Schedule: Tuesdays, 3:15 to 6:00 p.m., first five weeks of the quarter. Meeting dates 3/27, 4/4, 4/10, and 4/17 and most of the day (0600 to 1600) on 4/25.

Teaching Style: Engineering and Management of product innovation and prototyping processes will be investigated through lecture/class discussion, case study examination, and a field trip. Insight from the industrial experience of students formerly or presently involved with new product development and or prototyping is strongly encouraged.

References: There is no text for this course however a case pack with required readings and cases will be available. Note that assignments readings do not necessarily follow order of readings in case pack.
Recommended/Worthwhile reads from an innovators bookshelf.

- **Setting the PACE in Product Development** by Michael E. McGrath, Published by Butterworth-Heinemann, 1996. A nice overview of product innovation processes from a traditional point of view. Frameworks and planning tools/procedures are discussed at length. This book is available in the Evanston Norris Center bookstore (847-491-5812) for about $20. Please let me know if the bookstore runs out.

- **The Art of Innovation**, by Tom Kelley, Interesting read that describes how the most successful product design firm in history (IDEO) plan, executes and otherwise manages its internal innovation processes. Fascinating insight on how to manage VERY creative people. This book is available in the Evanston (847-491-5812) bookstore for about $26.

- **Invention by Design** by Henry Petroski, Published by Harvard University Press, 1996. This is an excellent book examining how innovation occurs and is captured in new products. Commercial innovation of both simple (paper clips) and complex (airplanes, FAX and networks, skyscrapers.. pre 9/11/01 World Trade Center design discussion is very interesting) products is described. Available on line paperback for about $20.

- **Clockspeed**, by Charles Fine, This work analyzes cycles of products, process, and organizational innovations in fast moving industries. Using biomimicry, the author makes an analogy between the principles of genetics and supply chain choices driving company and industry evolution. Author stipulates that we are now entering an age of "temporary competitive advantage". Available online for about $16.


- **Design Rules**, by Baldwin and Clark. An interesting, in depth review of the multiple ways that Modular Design influences the growth and expansion of an industry. Using the example of the computer industry, these authors carefully demonstrate how modular design has sparked rapid growth and enhanced diffusion of innovations. On line for about $50.
Course Content and Schedule:  *(Order subject to Change)*

CLASS SESSION #1  Date:  Tuesday, March 27,  3:15 to 6:00 p.m., ITW class room FORD Center

Subject:  Introduction to Rapid Product Innovation

Discussion Topics:

⇒ Review of course syllabus, teaching method, student responsibilities, form study groups
⇒ How does this course fit in the sequence, help with the Product Fair?
⇒ Course overview, syllabus
⇒ NPD and Innovation, the Taxonomy
⇒ Schumpeter and wealth creation
⇒ Innovation and Invention
⇒ Invention of Spread Spectrum Technology
⇒ Products and Prototypes
⇒ The evolution of form through expression
⇒ Classifying prototype methods
⇒ Product Design
⇒ Strategic importance of Design
⇒ The economics of First and Second movers
⇒ Prototyping in the Context of Rapid Product Development
⇒ The Prototype as an enabling, learning technology
⇒ Computer Aided Rapid Prototyping (CARP) environment
⇒ Computer Integration and the Manufacturing Enterprise Wheel

Readings/Assignments  for Next Class (4/3):

1. Become familiar with content of Blackboard class web site.
2. Read *Rapid Prototyping and Solid Free Form Fabrication*, J. Mfg. Sci. article case pack
5. Read and prepare *Ryobi Outdoor Products* Case Questions, individual assignment.
CLASS SESSION #2  Date: Tuesday, April 3, 3:15 to 6:00 p.m., ITW class room FORD Center

Subjects: Rapid Prototyping and Mechanical Prototyping Technology

Discussion Topics:
⇒ CARP Diagram and logic
⇒ Associativity in CAD systems
⇒ PDM systems
⇒ The CAD solid model
⇒ The solid, 3D facsimile
⇒ Stereolithography
⇒ Laminated Object Manufacturing
⇒ Solid Ground Curing
⇒ SLS, SGC, FDM, DSP and other processes
⇒ Using these facilities at NU for the Design Fair Competition
⇒ Management issues
⇒ CASE DISCUSSION: Ryobi Outdoor Products Case

Readings/Assignments for Next Class (4/10):
1. Prepare BMW A case and group assignment for discussion in session #2

CLASS SESSION #3  Date: Tuesday, April 10, 3:15 to 6:00 p.m., ITW class room FORD Center

Tentative Visit by Mr. Yamada, CEO of INCS Japan

Lecture Subject: Rapid, volume procurement of prototype components (Rapid Tooling)

Discussion Topics:
⇒ CARP and rapid tooling
⇒ Volume prototyping and the production intended material conundrum
⇒ SFFF and extensions to cores and cavities
⇒ Casting of cores and cavities from the CAD solid model
⇒ Cell phone example
⇒ Nissan Mud flap example
⇒ Ford Read Explorer rear window wiper motor cover example
⇒ Economics of the options
⇒ Time savings comparisons
⇒ CASE DISCUSSION: BMW A, B Case discussion

Readings/Assignments for Next Class (4/17):
1. Read and Prepare Team New Zealand A Case, individual assignment Questions (this is not a team based assignment, individual submissions required)
CLASS SESSION #4  Date: Tuesday, April 17, 3:15 to 6:00 p.m., ITW class room FORD Center

Subjects: Softprototyping and Computer Automated Engineering Tools

Discussion Topics:

⇒ CARP and the role of the soft prototype
⇒ CAE Methods
⇒ Static and dynamic loading analysis
⇒ Computational Fluid Dynamics
⇒ The role of meshing methods
⇒ Complex design systems and CAE
⇒ Design for Foundry processing
⇒ Design for Inspection
⇒ Design for spectrum loading
⇒ Design for Damage Tolerance
⇒ A CAE system at the nexus
⇒ Time Critical Engineering Challenges
⇒ The Americas Cup Competition
⇒ Tank and Tunnel Testing
⇒ CFD codes and the Velocity Prediction Program
⇒ Noise and testing methodologies
⇒ Determining the appropriate strategy
⇒ Team NZ Case B
⇒ Team NZ Case C
⇒ Revisiting the Ryobi Case
⇒ Course Summary

⇒ CASE DISCUSSION: Team New Zealand A, B, C

CLASS SESSION #5  Date: Wednesday, April 25, All day event, return to campus approx 4:30 p.m.

Subject: Field trip to Hermann Miller and Johnson Controls Product Innovation campuses in Holland Michigan

⇒ On line CTEC Course Evaluations to be completed after this week.

Readings for future interest:

2. Developing Products on Internet Time, Article case pack
Case Assignments/Study Groups:

Case assignments typically pose a number of questions that should be efficiently addressed in a one or two page write-up. You are expected to form study groups of 2-3 students for discussion of the cases and notify me of your grouping by the end session 1 or as soon as possible by e-mail. We request that you stay in the same study group all quarter.

Classroom Etiquette and Class Participation:

Class discussion/ participation is an important element of this course and the overall learning experience at Kellogg/McCormick. Both your colleagues and the instructor WANT TO HEAR what you think about the subjects being discussed in this class.

All students are expected to fully comply with the Kellogg Code of Classroom Etiquette (http://www.kellogg.northwestern.edu/stu_aff/honor/etiquette.htm)

Please leave your name plate up for the entire duration of each class and keep the same seat for the duration of the quarter. Not having a name plate will impact class participation grade (monitored during each class by TA).

While you are welcome to use your computers for note taking and other class specific tasks such as accessing the Blackboard site, web surfing and e-mailing are expressly prohibited as requested by the KSA.

You are expected to attend all classes. If you have to miss class for any reason, you must notify the instructor by e-mail before the scheduled start of the session. An unexcused absence will result in a reduction in class participation grade.

Much of the learning in this course comes from class discussion. Your classroom participation grade will be based on attendance, preparation, familiarity with the reading materials, and the quality of your contribution. Some of the key characteristics of valuable contributions are as follows:

- Relevance: Are your comments timely and linked to the comments of others?
- Advancement: Do your comments take the discussion farther or deeper than previous comments?
- Fact-based: Have you used specific data from the case, from readings, or from personal experience to support the assertions that you are making?
- Logic: Is your reasoning consistent and logical? Do you use concepts from the readings or lectures correctly?
- Originality: Do your comments merely restate the facts or do they provide new insights?

Generally, an important indicator of participation is your contribution to the creation of a positive learning environment. For example, correcting me when I make a mistake or asking what appear to be “dumb questions” about what is being covered both do help.

To increase opportunities for effective participation, I will cold call students either to open the class or during the course of a discussion. If you feel that you are preparing well but that I am not calling on you often enough, please let me and the TA know so that we can adjust.
Grading:

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<thead>
<tr>
<th>Grade Component</th>
<th>Individual / Group</th>
<th>Week</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td>Class Participation</td>
<td>Individual</td>
<td>All</td>
<td>25 %</td>
</tr>
<tr>
<td>Case Write-ups/Assignments</td>
<td>Study Group</td>
<td>2,3</td>
<td>30 %</td>
</tr>
<tr>
<td>Final Case write-up</td>
<td>Individual</td>
<td>4</td>
<td>45 %</td>
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</tbody>
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Suggested Reading/Surfing:


- **Information Week on line Magazine**: [http://www.informationweek.com/](http://www.informationweek.com/)


- **M. Burns**, *Automated Fabrication: Improving Productivity in Manufacturing*: PTR Prentice Hall Inc. Publishers:


- **A. Lightman et al.**, *Proceedings of International Conference on Rapid Prototyping*: University of Dayton Publishing, Dayton Ohio..
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Spring Quarter 2006 Offering

CASE PACK CONTENTS:

1. Tentative Syllabus
3. Enterprise Integration in Japan CASA/SME White paper series
5. Cultures of Prototyping DMI Journal of Design
6. Ryobi Outdoor Products: Kellogg/MMM Case Study
7. Enterprise Integration at INCS KSM Technical Note
8. BMW: The 7-Series Project (A) Case Study
9. Team New Zealand (A) Case Study
11. Developing Products on Internet Time HBR Article