



## Rapid Product Innovation

IEMS 497 Section 05

Living Syllabus (version 2.0), 2/3/06

**MMM Mini Course Offering**

**Spring 2006, First Five Weeks of Quarter**

**Tuesdays and Selected Dates (3/28, 4/4, 4/11, 4/18) 3:15 – 6:00 p.m. and all day (0600 to 1600)**

**Wednesday 4/26 Jacobs Center room TBD**

**Courseinfo** [http://www.courses.nwu.edu/webapps/portal/frameset.jsp?tab=courses&url=/bin/common/course.pl?course\\_id=\\_111724\\_1](http://www.courses.nwu.edu/webapps/portal/frameset.jsp?tab=courses&url=/bin/common/course.pl?course_id=_111724_1)

### Course

**Description:** In order to sustain and grow market share in contemporary manufacturing industries, firms continually seek to innovate/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 Automotive product development (BMW), Defense industry product development (Boeing), America's Cup Yacht Race Engineering (Team NZ), Power equipment engineering (Ryobi Engines) and computer Hardware (HP Powerbar Case) in addition to a special case on the prototyping and product development methods of fast followers (Midwest Air Technologies).

### Special Addition

**2006 Offering:** In Fall Quarter 2004 offering of a similar course (Kellogg Tech 919) we experimented with a 1 day field trip to Johnson Controls Prince Innovation Center (automotive interiors) and the Herman Miller (furniture) Design Yard of Holland Michigan, commercial innovation centers with state of the art prototyping processes and methodologies. The success of these learning experiences has prompted the addition of a similar outing to this MMM IE497 offering, tentatively scheduled for Wednesday April 26, 2006. We can adjust trip date somewhat depending on participant schedule.

**Instructor:** James G. Conley, Professor, Kellogg School of Management, Professor of Industrial Engineering and Management Science. Office: Jacob Center 5251, x1-4814, Office hours by appointment e-mail: [j-conleya@kellogg.northwestern.edu](mailto:j-conleya@kellogg.northwestern.edu).

**Schedule:** Tuesdays, 3:15 to 6:00 p.m. , first five weeks of the quarter. Meeting dates **3/29, 4/5, 4/12, 4/19 and 4/20.**

**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 innovation asset management programs is strongly encouraged.

**References:** There is no text for this course however a case pack with required readings and cases will be available in the bookstore. Note that assignments readings do not necessarily follow order of readings in case pack

## IE497 Section 05 Rapid Product Innovation: Spring 2006 Course Syllabus (continued)

While there are no *required* textbooks for this course the following books provide considerable, deeper insight into the materials prepared and presented in lecture. They also provide some best practices examples that are useful beyond the classroom. A number of these books are available via electronic merchants and some may be available as used.

Recommended/Worthwhile reads from Prof. Conley's 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.
- *Developing Products in Half the Time* by Smith and Reinersten, An excellent book with an in depth treatment of development capacity constraints and the consequences of overloading. Available online for about \$40.
- *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.

**IE497 Section 05 Rapid Product Innovation: Spring 2006 Course Syllabus (continued)**

**Course Content and Schedule:** (*Order subject to Change*)

**CLASS SESSION #1** Date: Tuesday, March 28, 3:15 to 6:00 p.m., Room TBD Jacobs Center

Subject: Introduction to Rapid Product Innovation

Session 1 Required Readings (i.e. read these before coming to first class session):  
*Ryobi Outdoor Products Case Study and questions*

Prior to coming to class #1, each student should read and prepare the case questions for the *Ryobi Outdoor Products* case available on-line and in the case pack. Each individual student should prepare answers to these case questions as per the assignment and be prepared to discuss in class.

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?***
- ⇒ The economics of First and Second movers
- ⇒ Prototyping in the Context of Rapid Product Development
- ⇒ The Prototype as an enabling technology
- ⇒ A prototype is worth 10,000 words
- ⇒ Prototyping and DFM, DFA, DFS.....DFX
- ⇒ Rapid Prototyping and or Solid Free Form Fabrication (SFFF)
- ⇒ Computer Aided Rapid Prototyping (CARP) environment
- ⇒ Relevant prototyping strategy

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

1. Read and prepare Ryobi Outdoor Products Case Questions, individual assignment
2. Become familiar with content of Courseinfo class web site.
3. Cultures of Prototyping, Design Management Journal (recommended, courseinfo site)
4. Nelson Repenning and *Fire Fighting* Articles in case pack

**IE497 Section 05 Rapid Product Innovation: Spring 2006 Course Syllabus (continued)**

**CLASS SESSION #2** Date: Tuesday, April 4, 3:15 to 6:00 p.m., Room TBD Jacobs Center

Subjects: Rapid Prototyping and Mechanical Prototyping Technology

Discussion Topics:

- ⇒ Innovation and Inventions
- ⇒ CARP Diagram and logic
- ⇒ Associativity in CAD systems
- ⇒ PDM systems
- ⇒ The CAD solid model
- ⇒ The solid, 3D facimile
- ⇒ 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 (4/11):**

1. Prepare BMW A case and group assignment for discussion in session #2
2. Developing Products on Internet Time, HBR Article, Case Pack
3. Modular design articles, courseinfo site

**CLASS SESSION #3** Date: Tuesday, April 11, 3:15 to 6:00 p.m., Room TBD Jacobs Center

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 (4/18):**

1. Read and Prepare Team New Zealand A Case, individual assignment Questions
2. *Specifications, Do we really understand*, Horizons Article Case Pack
3. *Robust Engineering Design post Taguchi*, Phil Trans article case pack

**IE497 Section 05 Rapid Product Innovation: Spring 2006 Course Syllabus (continued)**

**CLASS SESSION #4** Date: Tuesday, April 18, 3:00 to 5:40 p.m., Room 276 Jacobs Center

Subjects: Softprototyping and Computer Automated Engineering Tools

Discussion Topics:

- ⇒ CARP and the 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 26, 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

- ⇒ Course Evaluations to be completed after this week.

**Readings for future interest:**

1. *Developing Products on Internet Time*, Article case pack
2. *Maxis Software Case A: KSM Case*, 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.nwu.edu/stu\\_aff/honor/etiquette.htm](http://www.kellogg.nwu.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 GMA.**

You are expected to attend all classes. **Attendance is mandatory for the midterm case discussion, for guest speakers and for the in-class final project presentations.** If you have to miss class for any reason, you must notify both me and the TA 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:**

Grade Component	Individual / Group	Week	Weight
Class Participation	Individual	All	25 %
Case Write-ups/Assignments	Individual, Study Group	2,3	40 %
Final Case write-up	Individual	4	35 %

Peer evaluation forms posted to the web will be used to assess individual contributions to group assignments. It is required that all individual students fill out a peer evaluation form. More details on this during class #1.

**Suggested Reading/Surfing:**

**Time Compression Technologies:** Trade Magazine Web Site <http://www.time-compression.com/>

**Information Week on line Magazine:** <http://www.informationweek.com/>

**M. Iansiti,** *Technology Integration: Making Critical Choices in a Dynamic World:* Harvard Business School Press, 1998.

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

**M. L. Patterson,** *Accelerating Innovation: Improving the Process of Product Development.* Van Nostrand Reinhold Publishing: New York, 1993.

**P. F. Jacobs,** *Stereo Lithography and other RP&M Technologies.* American Society of Mechanical Engineers Publishing: New York, 1996.

**H. Marcus et al.** *Proceedings of Solid Free Form Fabrication Symposium.* University of Texas at Austin Publishing, Annual, 1991 to Present.

**A. Lightman et al.** *Proceedings of International Conference on Rapid Prototyping.* University of Dayton Publishing, Dayton Ohio..

## IEMS497 section 05: Rapid Product Innovation

### Spring Quarter 2006 Offering

#### CASE PACK CONTENTS:

- |   |   |
|---|---|
| 1. Tentative Syllabus                               |   |
| 2. Ryobi Outdoor Products:                          | Kellogg/MMM Case Study                          |
| 3. Hewlett Packard PowerBar Server Development Case | Kellogg Case Study                              |
| 4. Understanding Fire Fighting in NPD               | Journal of Product Innovation Mgmt              |
| 5. Specifications-Do we Really Understand....       | Horizons Article                                |
| 6. Robust Engineering Design Post Taguchi           | Philosophical Transactions of the Royal Society |
| 7. BMW: The 7-Series Project (A)                    | Case Study                                      |
| 8. Team New Zealand (A)                             | Case Study                                      |
| 9. Developing Products on Internet Time             | Article   |
| 10. Maxis Software Part A                           | Kellogg Case Study                              |