Managing New Technology Introduction

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Portland State University

Prof. Paul R. Newman Ph.D.

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Office Hours: After class or by arrangement.

COURSE DESCRIPTION

EMGT 510/610 ET is a four-credit class graduate-level course structured around 11 lectures, material drawn from a textbook, various publications and web-based sources, and student directed library research and class presentations. Classes may also be augmented with presentations by several outside speakers.

The course is based on the management procedures and key underlying concepts for effective planning, development, and introduction into volume production of new products that utilize new technology. While emphasis will be on hardware manufacturing, most principles and methodology are generally applicable to both hardware and software technology management.

Issues of technology strategic planning, process definition and characterization, decision-making, technology transfer, product definition, yield improvement, and concurrent engineering principles will be explored to identify effective management approaches for shortening time to volume production, minimizing risks, and minimizing engineering effort. As part of the course students will form teams assigned either to develop a corporate procedure for the introduction of new products and manufacturing processes, each for a specific company situation, applying the concepts learned, or to carry out a case study of a specific company’s procedures. There are no prerequisites for the course, although some technical background and/or experience are desirable. The course is designed for those students interested in the key principles of how manufacturing technology is managed in industry, the reasoning behind these principles, best (and worst) management practices, and how they are implemented worldwide.
REQUIRED READING

Text:

1. **The Development Factory: Unlocking the Potential of Process Innovation** (Hardcover)  
   **(NOTE: You may purchase the required individual chapters as downloadable .pdf files directly from the HBS website. If you buy the entire pack of Harvard Publications, it will cost only $3.99/chapter)** You may use the following link to the course pack at Harvard Publications.  
   Note: the pack also includes the monograph #11 below:  
   
   [http://cb.hbsp.harvard.edu/cb/access/7644350](http://cb.hbsp.harvard.edu/cb/access/7644350)

2. **Measuring Innovation... Gauging Your Organization’s Success**, Tim Studt, R&D Magazine,  
   Feb, 2005, P 42-44 (Available on-line through the PSU Lib)

3. **CMMI**, Kay, Russell; Computerworld; 1/24/2005, Vol. 39 Issue 4, p28-28, 1p (Downloadable through the PSU library)

   [http://www.sei.cmu.edu/pub/documents/06.reports/pdf/06tr008.pdf](http://www.sei.cmu.edu/pub/documents/06.reports/pdf/06tr008.pdf)

5. **Technology Product Life Cycle, White paper from Myxa Corp.**  
   [http://www.myxa.com/wp_tplc.htm](http://www.myxa.com/wp_tplc.htm)

   (Downloadable through the PSU library)


8. **Finding Innovation Where It Lives.** By: Welch, Jack, Welch, Suzy, Business Week,  
   4/21/2008, Issue 4080 p084-084 (Downloadable through the PSU library)


    (Purchase on line at [http://www.hbsp.com](http://www.hbsp.com) or as part of the pack in reference above)


14. Forecasting emerging technologies: Use of bibliometrics and patent analysis, Tugrul U. Daim , Guillermo Rueda, Hilary Martin, Pisek Gerdsri, Technological Forecasting and Social Change Volume 73, Issue 8, October 2006, Pages 981-1012 (Downloadable through the PSU library)

15. 'Smart Growth': Innovating to Meet the Needs of the Market without Feeding the Beast of Complexity: Knowledge@Wharton; October 25, 2006 http://knowledge.wharton.upenn.edu/special_section.cfm?specialID=58


Optional Supplemental Readings –


COURSE OBJECTIVES –

**Standards for completing Assignments** --

**Submissions** -- Your completed assignments are due in writing in hardcopy format on Wednesday afternoon for each classroom session.

**Late Policy** -- You are expected to turn in assignments on time. If you think you will be unable to complete an assignment on time, please email the professor in advance. Otherwise you will receive a grade of “0” for that assignment. As there are a limited number of class sessions and class participation is a significant portion of your grade, you are expected to attend every class. If you expect to miss more than one or two sessions, you should not take this course.

**Plagiarism** -- You should note that using information without attributing its source constitutes plagiarism. In this course, you will do research and use a variety of media to complete assignments. If material is quoted directly from any source, the source must be cited in your deliverable. (Check with the professor if you are unsure of the citation formatting or placement.) The source of non-quoted information or statistics used in support of any point must also be cited, including information from websites and other online sources. Any submission that is not properly documented will receive a grade of “0.” You are expected to express your answers to the questions in the assignments primarily in your own words. Copying text word for word as a response is simply not acceptable unless it is properly referenced, and backed up with additional interpretation in your own words.

**Preparation** -- You will be expected to prepare for class by reading the assigned materials and completing the work as assigned. Although you are expected to be familiar with all the concepts and terminology introduced in the readings, you will not be required to memorize detailed information. You must be able to intelligently discuss the patterns, concepts, strategies, etc. described in each chapter of the text. You must also be familiar with the case studies throughout the book, as well as the historical case study monographs. You are expected to listen to the lectures each week, understand the concepts that are presented and contribute to the class discussion. Material presented during the lecture parallels the text and the historical studies, but frequently contains additional material not covered in these sources.

**Written Assignments** -- There are weekly reading assignments from both the text and selected case studies. The written assignments are to be turned in at the corresponding session. In other words, the written assignments are due on Weds. at the beginning of class. The assignments will be corrected and returned to you at the following session.

**Individual/Team Projects** -- The class will be divided into teams, made up of two to four students, each of which will carry out a project of their choosing covering the issues raised in the course. One possible project is to do a case study of a specific company’s procedures for defining, developing, and transferring into production new manufacturing technology. This, for example, might be a preferred project for a team made up of employees of a specific company. Alternately the teams can develop a corporate procedure for defining, developing, and transferring new technology into production, either using a real company as agreed with the instructor or with a hypothetical company assigned by the instructor. The corporate procedure will embody the principles taught in the course, and be intended as a manual for new employees which will describe how decisions are made, how products are developed, the terminology used, and how new technologies are defined, developed and transferred into production consistent with long range strategic planning. Hypothetical companies include the following:
• a semiconductor company specializing in high-performance, high margin IC’s
• a printer company
• a flat panel display company
• a silicon foundry
• a fabless semiconductor company startup
• an R&D lab within a large electronics company

At the end of the course each team will complete and hand in a copy of the corporate procedure, and prepare a 20-minute class presentation to describe its content and the reasoning behind it.

**Exams** --There will be no exams in this course.

**EVALUATION** –

The course evaluation will be determined as follows –

- **60% Individual Written Assignments**
- **30% Team Class presentation and discussion on a Process for Implementing New Technology in a Product.**
- **10% Individual Class Participation**

This course is not graded according to the number of pages, the number of words, or what font you use to write your papers. The answers to some questions may only require several sentences. Other questions may require a more extensive discussion. The actual volume of words is not the issue. Your grade will reflect your ability to understand ideas and communicate them to the professor in writing, as well as your participation and ability to communicate your ideas to the rest of the class in the classroom discussions.

**Course Schedule:**

Class will be held from 1730 to 2120 on Wednesday evenings in the BH Building on the Main Campus. There will be a 15-20 min break for dinner at around 1900.

**ABOUT THE PROFESSOR –**

PAUL R. NEWMAN, PH.D., Professor, Engineering & Technology Management

Dr. Newman has over 22 years of senior management experience in high technology companies such as Rockwell International Corporation, JBL Professional and Electro Scientific Industries. His educational background in solid-state physics has enabled him to make a number of significant technical contributions to these companies as evidenced by his 43 technical publications and 4 US patents. Over the years, his technical career evolved into one of positions of increasing management responsibility, strategic planning, and finally responsibility at the executive level. At Rockwell, Dr. Newman was promoted from Member of the Technical Staff to Group Manager, to Principal Scientist where he functioned as an internal consultant connecting the resources of the Corporate R&D Lab to the needs of the Operating Divisions. At JBL Professional, Dr. Newman was Vice President of R&D, and was
responsible for launching over 30 new products, reducing product development cycle time and improving overall product quality. He was the Director of Applied Technology for Electro Scientific Industries; a position that gave him responsibility for planning both long and short term strategic R&D for the company. Currently Dr. Newman is President of Cooper Mountain Research, Inc., an independent consulting firm focused on the strategic management of science and technology. In addition to teaching at the State University of New York at Stony Brook, he also is an adjunct professor at the Department of Management in Science & Technology at the Oregon Graduate School of Science & Technology, at the Oregon Health & Sciences University in Portland, Oregon, and has taught business courses overseas in Vietnam, Korea and China. Dr. Newman obtained his BS degree in physics from Antioch College, his Doctorate in physics from Michigan State University, and did Post Doctoral work at the University of Pennsylvania’s Laboratory for the Research on the Structure of Matter.
Learning Objectives:

After completing this unit, you will be able to understand:

- Introduction, Course Description, and Course Objectives -
- A discussion of the management problems to be addressed in the class,
- How they will be addressed, defines terminology, and provides some general principles involved in new manufacturing technology introduction with emphasis on the “learning curve” principal of optimally building knowledge and capability from that which exists.

Team Assignment: (To be carried out tonight)

1. Form teams of 5~6 students to a team. Each team will be developing a procedure for identifying, evaluating, validating and transferring new technology into production, either using a real company as agreed with the instructor or with a hypothetical company assigned by the instructor.

The corporate procedure will embody the principles taught in the course, and be intended as a manual for new employees

Hypothetical companies include the following:

- a semiconductor company specializing in high-performance, high margin IC’s
- a printer company
- a flat panel display company
- a silicon foundry
- a fabless semiconductor company startup
- an R&D lab within a large electronics company

Homework Assignment to be completed by Weds, 1/5/2011

Answer the following questions based on the reading assignment:

1. In your own words, based on the text The Development Factory, when companies introduce new products into the market, what are the objectives and drivers? (30 pts)

2. What is the role that “quality control” plays in the production of saleable goods and why is it so important? (30)

3. Explain the differences between the two different kinds of products (breakthrough & sustaining) and what is the role that technology plays in the development of new products. (30)

4. What specific learning objectives do you have for this course? (10)
Learning Objectives:

After completing this unit, you will be able to Understand:

- How to capture “real” versus perceived customer needs
- Joint Development with key customers & Suppliers
- The use of Quality Function Deployment to optimize product performance relative to customer needs
- Market segmentation and the relation of one product to its market segment and the rest of the market
- How QFD can be captured in a software development tool
- The influence of global regulatory issues on product development programs

Assignments to be completed by Weds, 1/12/2011

Assigned Reading:

1. The House of Quality, Hauser, J.R., Clausing, D.; Harvard Bus. Rev. May-June 1988, Prod. No. 88307, (Note: While this is one of the classic papers on QFD, you only need to read Pp 1-10, and concentrate on just the first house). Those who want a more in-depth discussion of QFD might consult the optional suggested reading:

   House of Quality (QFD) in a Minute (Paperback), 2nd Ed.; Christian N. Madu (Author); Chi Publishers; Second edition (November 1, 2000); ISBN: 978-0967602301


Answer the Following questions based on the reading assignments:

1. What is “feature creep” and how is the risk of this phenomenon increased by having separate marketing & engineering documents? (20 pts)

2. Referring to the practices in “Is your New Product...”, how can you maintain a NPD process, follow rapidly changing customer demands, avoid “feature creep”, and still get something released to the market? Is this type of process applicable to products in your business? (Be sure to explain why or why not.) (10 pts)

3. What are some practical ways of capturing real customer preferences (as opposed to the “next bench” phenomenon) as far in advance as possible? Look at Fig 2 in “Is your New Product...” and explain why customer involvement is so important. (20 pts)

4. What is meant by concentrate on benefits (value) rather than features (the “way cool” factor)? (An example or two might help.) How do you avoid the pitfall of overly focusing on features? (20 pts)

5. How is QFD useful to the front end of the Product Development process? What are the dangers in using it? How might your team use it in the upcoming product review exercise (cf Unit 10)? (20 pts)

6. How does your company get the kind of data that allows it to compare its products’ performances relative to the competition? (10 pts)
Learning Objectives:

After completing this unit, you will be able to understand:

• Where to look for new and emerging technology
• How to evaluate a technology’s maturity using some evaluative “tools”
• Understand the process of accessing technology and implementing it in the “fuzzy front end” of new products
• Assuring that the technology is accessible through gap identification in core competencies

Assignments to be completed by Weds, 1/19/2011

Assigned Reading:


3. Forecasting emerging technologies: Use of bibliometrics and patent analysis, Tugrul U. Daim, Guillermo Rueda, Hilary Martin, Pisek Gerdsri, Technological Forecasting and Social Change Volume 73, Issue 8, October 2006, Pages 981-1012

Answer the Following questions based on the reading assignments:

1. What is the “technology maturity model” (of Daim et. al)? How does it work? What is the raw data for input and what is the output? (20 pts)

2. In Technology Forecasting, review the 9 different models for technology forecasting. Which one or two do you find most practical and/or applicable to real world situations? Why? (20)

3. Also in Technology Forecasting, the section on TRIZ indicates 3 main descriptors of the technological maturity. Describe each descriptor and indicate for each whether you think it is a valid approach or not and why. (30)

4. In How Do Engineering… What is “Gap Analysis?” (10)

5. Also in How do Engineering... Examine the graph in Exhibit 8 for Technology Utilization (leftmost). Then compare the top 3 there with the top 3 in the Economical area (top right). Which ones do you feel are most important overall to the success of a technology driven business. (20)
### Learning Objectives:

After completing this unit, you will be able

To understand:

- the stage- or phase-gate system of product life cycle management;
  - its evolution,
  - its advantages and disadvantages,

- the application of the principles to the development and introduction of new manufacturing technologies;

- the three management and decision-making levels in companies,
  - the business level,
  - the project level, and
  - the implementation level,

- and relate these to manufacturing process life cycles.

### Homework Assignment to be completed by Weds, 1/26/2011

### Assigned Reading:

   


### Answer the following questions based on the reading assignment:

1. In your own words, based on the readings, describe the “stage gate” or phase gate process. What is it? Why do organizations use it? What are the objectives? (30 pts)

2. While Stage Gate process may be an effective way of organizing a single project, what can happen if multiple projects are operating in a stage gate mode, simultaneously? (20 pts)

3. Describe what the “Product Life Cycle”, the various phases or stages mean during this process, and what goes on during each phase. (Note: DO NOT SIMPLY COPY THE CHARTS. You may use the same terminology, but paraphrase in your own words what each phase does). (30 pts)

4. In Phase Reviews... what do you think the “success factor” is for new product concepts (How many actually make it into the product pipeline)? Support your answer using the research results cited “Phase 0” in the case study. Do you agree? Is the number too high? Too Low? (20 pts)
**Learning Objectives:**

After completing this unit, you will be able to understand:

- some of the fundamental manufacturing management principles important to the development and introduction of new manufacturing technology, with particular emphasis on process control and yield.

- a brief and general overview description of semiconductor manufacturing aimed at those students unfamiliar with the industry, to provide the base of understanding necessary for the management principles to be discussed later in the course.

**Team Assignment:**

1. Begin your development of a process by laying out the “30,000 ft view” or the overall development process for the product or organization you have chosen.

2. Indicate where in the process you think there may be some key decision points. How do you want to capture the decisions? Meetings? Documents?

**Homework Assignment to be completed by Weds, 1/2/2011**

**Assigned Reading:**

   Product #: 5144BC, 1996, 41p


**Answer the following questions based on the reading assignment:**

1. From the text, consider: “...If you try to do too much process development, you'll delay the launch. That’s never worth it....” Next look at the graph in Fig 4.2 Explain the conflict between the two. Which one do you believe? Why? (30 pts)

2. Also in the text, the author states “..the relevant window for process development is not the entire development cycle.” Tell what the “window of opportunity” is for the pharmaceutical industry. Are there similar windows for other industries? (20pts)

3. Turning to “Measuring Innovation...”, examine the list of measurements and indicate your top 5 metrics. Explain your choices and in the case, your choices don’t agree with the survey, explain why. (20)

4. Explain the statement: “R&D Productivity is not strongly related to the quality of patents held by an organization.” Do you agree? Explain why or why not. (10)

5. Finally, examine the key components for successful innovation. Indicate which ones you think are the most important. Explain your choices, and any differences between your choices and those in the survey. (20)
Learning Objectives:

After completing this unit, you will be able to understand:

- How to innovate, but maximize the likelihood of an innovative product’s business pay-off
- The importance of time in New Product Introduction
- How to capture company cross functional excellence in Product Development Teams
- How to evaluate new product concepts—the technology opportunity council
- What kinds of innovation are present in forward thinking technology driven companies?

Assignments to be completed before Weds- 2/9/2011

Assigned Reading:


Answer the Following questions based on the reading assignments:

1. While your professor hates to date himself, I often use the “3-legged milk stool” model for product development teams. What is the advantage of a 3-legged stool over say 2, or 4? For a new product development project, what should each of the legs represent? (20 pts)

2. In the “Meeting the Challenge...” case study, who and at what level are priorities for NPD projects set? What provides a framework for making these decisions? Analyze the situation in your company against these criteria. (30 pts)

3. In “Finding Innovation”, consider the opening question submitted by “Anonymous” at the top of the article... Do you agree that his is a fairly common situation? Why? (10)

4. Do some research and find out who Jack Welch is. What has he written? He indicates about how innovation is thought to emerge, and how it actually does. What does he mean and do you agree? Next examine the section where he describes group organizations within a company—what are these? What do they do? Indicate what specific people (functional organizations) should participate and why. (20)

5. In today’s “hypervelocity” markets, explain the dilemma between the security of sustaining product development and challenge (meaning risk) of entirely new and disruptive product innovation. (20 pts)
Learning Objectives:
After completing this unit, you will be able
To understand:
• How products, processes, and projects are partitioned for most effective management and implementation,
• role and definition of technology roadmaps;
• how projects are reviewed and progress tracked for effective management;
• how decisions are made and communicated;
• how knowledge and capability are built, and
• how projects can optimally build on existing capability and knowledge.

Homework Assignment to be completed by Weds, 2/16/2011

Assigned Reading:
2. CMMI, Kay, Russell; Computerworld; 1/24/2005, Vol. 39 Issue 4, p28-28, 1p

Answer the following questions based on the reading assignment:
1. Explain in your own words what “CMMI” refers to. Although it was originally developed for the software industry, do you think it can be applied more broadly to other products? (10pts)

2. Choose a process commonly used in high-tech companies such as “initial product design” (or any other one you can think of) and make up a maturity model for it filling in each of the 5 levels of maturity. (30 pts)

3. In Sustained Product Innovation…, the authors state: “First, we found that where individual innovation projects were successful, they depended on the efforts of particular individuals … they did not result from an organization-wide commitment.” State why this is common and illustrate your answer with the case study of CHEMCO. (20pts)

4. Also in Sustained Product…, the authors state: “.. that strategic support from senior management was nonexistent or only temporary.” What is the result of this type of organizational behavior? Pay particular attention to things like resources and schedules. Support your conclusions with the case studies. (20 pts)

5. Indicate what the authors’ conclusions are in terms of the needs of the innovator in terms of “power.” Why do you think organizations are so reluctant to enable this? (20 pts)
**Unit 8** Wednesday Feb 23rd, 2011 – Process Development Project Management;

### Learning Objectives:
After completing this unit, you will be able to understand:

- Management & Control—How much is enough? Too much?
- Product & Process R&D
- Learning before doing
- Learning While Doing
- Why the period before actual production development is the “bargain basement” for overall improvement
- Why Mature companies spend more on process R&D than product R&D

### Assignments to be completed before Weds. 2/23/2011

### Assigned Reading:


### Answer the following questions based on the reading assignment:

1. What is SPC (Statistical Process Control) and why is it important to manufacturing? What are the benefits of employing this tool? (10 pts)

2. The text points to what most companies consider the traditional starting point for tracking process improvement. What period in time does this thinking that the author considers critical to improving processes ignore? Do you agree with him and why or why not? (20 pts)

3. Why doesn’t a well executed “New Product Develop” Engineering Process, no matter how well it is designed, and how skilled the engineers, result directly in high quality cost effective products? (20 pts)

4. The author discusses the difference between *product* R&D and *process* R&D. He then goes on to say that in a mature company, the bulk of the R&D is process R&D. Discuss why this is so. (10 pts)

5. In talking about process improvement (learning before doing), and production learning (learning while doing), discuss why both are important, but why process improvement may in fact be the “bargain basement” of business improvement. (Where you gain the greatest advantage for the least cost) (20 pts)

6. While the author points to many instances where “learning before doing” in a laboratory environment might pay big dividends in cost reduction and quality improvement, what can happen to make this approach *ineffective* and perhaps even wrong? (20 pts)
### Learning Objectives:

After completing this unit, you will be able to understand:

- How to design for manufacturability
- Selecting & Qualifying External vendors & the impact on quality
- Carrying out the Manufacturing Support Build
- Pursuing the first Pilot Production
- Achieving a robust timely first customer ship, and achieving continuous improvement
- the concept of "Complexity" in product portfolios and its inherent dangers
- the silo approach to NPI

### Assignments to be completed before 3/2/2011

### Answer the Following questions based on the reading assignments:

1. One of the techniques that the window blind designers used to test out their design before they went to production was “rapid prototyping.” What is rapid prototyping and why did they feel it is not optimal for their purposes? (10)

2. Current wisdom counsels building on the past (re-usable technology) by designing to existing processes and components. What danger does this type of behavior pose in today’s hyper-velocity markets? (10 pts)

3. Putting a manufacturing engineer on the product development team is pretty obvious. Have you, or have you ever seen a design engineer working down on the factory floor? What might be the benefits of that? (10 pts)

4. What is “root cause analysis” and why is it important to continuous improvement? (10 pts)

5. In “Smart Growth”, the authors discuss “complexity” as it relates to new products. Explain what that means and what are the dangers in over-complexity. (20 pts)

6. Also in “Smart Growth” the authors discuss one of the most common problems in NPI today—the “Silo” pattern.” Explain this product development behavior and what the consequences are. Do you find elements of this behavior in your organization? (20 pts)

7. Explain how companies can invest significant resources in very innovative R&D—and still lose in the market. (20 pts)
Unit 10  March 9, 2011 – Team Project Presentations

Learning Objectives:

After completing this unit, you will be able to:

- Put together a product development plan
- Establish a preliminary pro forma business plan for the new product establishing pricing structure, COGS, and average margins.
- Put together an action plan and schedule and present it in the form of a Gantt Chart.
- Present the proposed project effectively, addressing issues such as:
  - Market driven performance objectives
  - Development program processes, costs and resource requirements
  - Risk Assessment and management
  - Regulatory issues if any

Team Assignments to be completed before 3/9/2011

1. Put together a 20 min. presentation of your business process. Make sure you cover all details of decision making, responsibility, documentation, etc..

2. Submit a written “Executive Summary” of your program, which is a brief synopsis of your plan—probably no more than 5 pages.

Grades will be given to each team according to how complete their presentation is & how it stands up to critical questioning.
Learning Objectives:
After completing this unit, you will be able
To understand:
- the principles of “soft transfer”: the initial transfer of only operational responsibility for a new module or process to manufacturing,
- followed by the transfer of engineering responsibility after manufacturability is demonstrated.
- the decision-making procedures,
- the criteria for transfer, and
- the principles involved for expediting manufacturing process introduction and production ramp.

Assignments to be completed before 3/16/2011

Answer the Following questions based on the reading assignments:
1. Define in your own words the concept of “agile manufacturing,” (50)
2. One of the authors cautioned against speed-to-market in spite of its virtues and wrote that “using speed as a strategy must be planned carefully, for otherwise speed can be fatal.” Explain this statement and why it is true or not. (40)
3. Explain the key learnings you took away from this course, what the benefits to you are, and what your overall reaction to the course is (10)