

ME317A Design for Manufacturability: Product Definition for Market Success
Mechanical Engineering Department, Design Division
STANFORD UNIVERSITY (Year 2008)

- Units:** Four
- Meeting time:** Two lectures per week, MW 4:15–5:30. Thornton 102.
- Course Director:** *Kos Ishii*, Office: Terman 509. (650) 725-1840, currently on leave.
ishii@stanford.edu
- Instructors:** *Kurt Beiter* (Assoc. Director, Mfg. Modeling Lab): Thornton 209. (650) 723-7340.
kbeiter@stanford.edu
- Edith Wilson* (Consulting Professor): (707) 431-1490, (707) 953-0342 (cell).
EdithWil@stanford.edu
- Staff Assistant:** *Sandi Cano*, Office: Thornton 207. (650) 724-4786.
scano@stanford.edu
- Teaching Assistants:** Thornton 207. (650) 723-7306, fax (650)723-7349.
Bryan DeMare, bdemare@stanford.edu
Whit Fowler, wfowler@stanford.edu
Sun Kim, ksunkist@stanford.edu
Karthik Manohar, manohar@stanford.edu
Jenny Wong, cjwong1@stanford.edu
- Mentor:** *Ken Waldron* (Professor-Research): Terman 521. (650) 736-1412
kwaldron@stanford.edu
- Textbook:** None
- Course Reader:** Download PDF from the Course Website (c.f. below)
- Course URL:** <http://me317.stanford.edu>
- Type of Instruction:** Lecture, 3 hours per week. Involves 4 homework sets on product definition and a team project on practical applications. Prerequisite: BS in Engineering or consent of instructor.
- Grading:** Homework: 40% Project: 50% Class Contribution: 10%

Course Summary:

ME317A&B address systematic methodologies to define, develop, and produce competitive products. The methods cover characterization of user values, design for manufacturability, and other life-cycle values such as reliability, serviceability, and environmental compatibility. ME317A addresses key issues of competitive product development. In the course project, student teams identify opportunities for improvement and apply structured methodologies to develop a comprehensive product definition. *Students must take ME317B and finish the project to receive a grade in ME317A.*

About the Project:

On-campus project teams (3-4 students) will choose a project from those supplied by our industrial partners. SCPD students must form their own teams (2-4 students) and define their own projects drawn from their workplace. The project will emphasize the definition of a product or process that will be competitive in the world market. The final deliverable of the project is a comprehensive product definition and specification.

Course Contents:

- What is world class? Customer Value Chain Analysis
- Functional Analysis, and Value Engineering
- Product Definition and Concurrent Engineering
- Customer Requirement Management, Quality Function Deployment, Benchmarking
- Cost Driver Identification, Cost-Worth Analysis
- Design for Assembly
- Design for Variety and Product Architecture
- Process and Material Selection
- Design for Producibility and Process Analysis
- Ownership Quality and Failure Modes and Effects Analysis
- Design for Serviceability
- Amorphous Products dfM
- Quality Scorecarding Basics
- Project Final Presentation

COURSE SCHEDULE**Meeting #1 (1/9 Wed): Orientation (Beiter/Wilson)**

- Course description
- Ingredients of world class competitiveness
- Structured methods
- Customer Value Chain Analysis

Reading:

- 1.1 Ishii, K., "Introduction to Design for Manufacturability (dfM)"
- 1.2 Barkan, P., "A Road Map through the ME317 Product Development Process"
- 1.3 Donaldson, K., Ishii, K., Sheppard, S., "Customer Value Chain Analysis"

Assignment:

- Begin searching for homework partner.
On-campus students: turn in class registration form (hardcopy required, due 1/10 17:00PST)
HW#1: Value Graph and Functional Analysis (Due 1/23)

Meeting #2 (1/14 Mon): Value Engineering (Wilson)

- Value Graph
- Functional Analysis

Reading:

- 2.1 Ishii, K., "Value Engineering (Value Identification and Functional Analysis)"
- 2.2 Ishii, K. and Mukherjee, S., "Development of AMX-4 Mobile Radiography System"
- 2.3 Ishii, K. and Thomas, P., "Redesign of Air-Cooled Generators"

Meeting #3 (1/16 Wed): Identification and Flowdown of Customer Needs (Wilson)

- Eliciting and Organizing Voice of Customer
- Quality Function Deployment
- Introduction to product variety challenges

Reading:

- 3.1 Martin, M., "Voice of the Customer"
- 3.2 Martin, M., and Ishii, K., "Introduction to Quality Function Deployment"

On-campus students: Project offering meeting at 6:00pm-8:00pm, Thornton 102

Assignment:

- Sign up for Projects (Due 1/17 12:00 PST)
Project Teams formed 1/18

No Meeting 1/21 MLK Day Observed**Meeting #4 (1/23 Wed): Product Vision (Wilson)**

- Project Financial Failure Modes
- Product Definition Assessment

Reading:

- 4.1 Wilson, E., "Maximizing Designers' Impact on Market Success through Product Definition, 2008"
4.2 Wilson, E., "Product Definition and Checklist"

Assignment:

HW#2: Quality Function Deployment and Value Analysis (Due 2/6)

Due:

HW#1: Value Graph and Functional Analysis (Can Opener) + CVCA (Project)

Meeting #5 (1/28 Mon): Life-cycle Cost Drivers (Wilson)

- Identification of cost drivers
- Cost sensitivities

Reading:

- 5.1 Ishii, K. and Kmenta, S., "Life-cycle Cost Drivers and Functional Worth"
5.2 Barkan, P. and Ishii, K., "Design Issues Related to Product Cost and Product Profitability"

Meeting #6 (1/30 Wed): Assembly Analysis (Brent Cheldelin – guest lecturer)

- Design for Assembly

Reading:

6.1 Ishii, K. and Kmenta, S., "Introduction to Design For Assembly (dfA)"

Meeting #7 (2/4 Mon): Product and Process Complexity (Beiter)

- Assembly Quality Evaluation
- Supply Chain Complexity

Reading:

- 7.1 Cheldelin, B. and Ishii, K. "Mixed Model Assembly: An Approach to Prevent Human Errors"
7.2 Manohar, K. and Ishii, K. "Supply Chain Complexity Metrics"

Meeting #8 (2/6 Wed): Design for Variety (Beiter)

- Design for Variety
- Platform Architecture

Reading:

8.1 Martin, M., "Design for Variety: Development of Complexity Indices and Design Charts."

Assignment:

HW#3: Design for Assembly (Due 2/20)

Due:

HW#2: Quality Function Deployment and Value Analysis
Project Abstract

Meeting #9 (2/11 Mon): Process and Material Selection (Beiter)

- Process and Material Selection
- Preliminary Geometry Design

Reading:

9.1 Beiter, K., and Ishii, K., "Design for Producibility (dfP)"

Meeting #10 (2/13 Wed): Design for Producibility (Beiter)

- Design for Injection Molding
- Process Analysis

Reading:

10.1 Beiter, K., et al “Summary of Basic Injection Molding Design Guidelines”

Assignment:

Project status report: PPT with Project QFD and optional notes (Electronic, Due 2/20 12:00PT)

.....
No Meeting 2/18 Presidents Day Observed
.....

Meeting #11 (2/20 Wed): Project Status Report

- Project Status Presentation

Assignment:

HW#4: Failure Modes and Effects Analysis (Due 3/5)

Due:

HW#3: Design for Assembly

Meeting #12 (2/25 Mon) Failure Modes and Effects Analysis (Beiter)

- Introduction to Ownership Quality
- Failure Modes and Effects Analysis

Reading:

12.1 Kmenta, S., and Ishii, K., “Failure Modes and Effects Analysis”

Meeting #13 (2/27 Wed): Amorphous Products dfM (Beiter)

- Applying ME317 Methods to Software and System Products
- Software Design for Variety

Reading:

13.1 “Beiter, K, Yang, T, and Ishii, K. “Preliminary Design of Amorphous Products”

Meeting #14 (3/3 Mon): Design for Service Innovation (Beiter/Kim)

- Serviceability Design
- Service as a Business

Reading:

14.1 Kmenta, S. and Ishii, K., “Design for Serviceability”

14.2 Kim, S. and Ishii, K., “Scenario-based Design”

Meeting #15 (3/5 Wed): Product Definition to Quality Scorecarding (Beiter)

- Clarifying the Strategic Alignment, CVCA, and PPM (XYY Nina Case)
- Scorecarding Fundamentals (Big Ys, Vital Xs)
- Project QFD

Reading:

15.1 Chao, L. and Ishii, K., “XYY Robotics Nina Project”

Due:

HW#4: Failure Modes and Effects Analysis

.....

Meeting #16 (3/10 Mon): Concept Generation (Beiter; CRITICAL TO PROJECT, ATTENDANCE MANDATORY)

- Planning for ME317B
- Concept Generation
- Functional and Morphological Design

No Reading: End-of-quarter relief

.....

Meeting #17 (3/12 Wed): Final Presentation 4:15-7:30pm (ppt file due @ 12:00PT)
(Final Report due @ 12:00PT on 3/13)

.....

ME317B: Design for Manufacturability: Quality by Design

Building on ME317A, students apply structured methods to optimize the design of an improved product, and plan for its manufacture, testing, and service. The project will focus on improving a product to make it more competitive in the world market. The project deliverable is a comprehensive proposal and specification for the new design.

Course Contents:

1. Review of the Product Definition Methods / Prototyping Rapidly
 2. Concept Selection: Pugh's Method
 3. Quality by Design: Optimizing the Business
 4. Design for Robustness: Basics
 5. Robust Parameter Design: Design of Experiments and Taguchi Method
 6. Robust Design Applications
 7. Robust Conceptual Design
 8. Zero Defects and (Poka Yoke) Error Proofing
 9. Design for Variety and Platform Sigma
 10. Scenario-based Failure Modes and Effects Analysis
 11. Amorphous Products dfM
 12. Risk Management in Product Development
 13. Decision Analysis-based Net Present Value Scorecarding
 14. Testing and Validation
 15. Towards Advanced dfM
-

ME317A HOMEWORK ASSIGNMENTS

1. Homework Groups

There are four homework assignments. The first one is to be done in groups of two. The rest are to be done by the project team. Each group/team is to submit ONE assignment.

2. Homework Topics

HW1: Customer Value Chain Analysis, Value Graph, Functional Analysis

HW2: Quality Function Deployment, Cost Worth Analysis

HW3: Design for Assembly and Producibility

HW4: FMEA, Design for Ownership Quality

3. Example Products to be used in the Homework

We will be using several product examples for the homework assignments.

HW1, HW2:	Can Openers
HW3:	Video Cassette
HW4:	Project Topic

Each team will need to purchase two types of can openers and one video cassette. The instructor will guide the students in class about which types of products to purchase.

4. Due Dates

Due dates are as indicated in the syllabus. Video tape delay students should shift the homework schedule accordingly.

5. Handing in your Assignment.

On campus students should submit their homework in class or to the Thornton 207 by 4:15 pm of the due date.

SCPD students should follow the specified routing.

Make copies of everything you hand in.

We expect a professional looking report.

We will accept NO late homework.

ME317 PROJECTS

There will be a separate handout for the details of the course project. **The project team size is to be no more than four.**

On-campus students will work on projects provided by industry partners. We ask SCPD students (NDO & HCP) to identify their own projects.

Key Dates for on-campus students

1/16/2008 (Wed)	Project Offering Meeting
1/18/2008 (Fri)	Project Teams Announced
2/20/2008 (Wed)	Project Status Presentation (ppt files due 1200PT)
3/12/2008 (Wed)	ME317A Final Presentation (1615-1930PDT) (ppt files due 1200PT)
3/13/2008 (Thurs)	ME317A Final Report (by 1200PDT)
6/2/2008 (Mon)	ME317A&B Overall Final Report (by 1200PDT, no exception)
6/4/2008 (Wed)	ME317A&B Overall Final Presentation (1615 – 1930PDT) (ppt files due 1200PT)