

ME317A Design for Manufacturability: Product Definition for Market Success

Mechanical Engineering Department

STANFORD UNIVERSITY (Year 2009, version 0.7)

Units:	Four
Meeting time:	Two lectures per week, MW 4:15–5:30. Thornton 102.
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Teaching Assistants:	<i>Whit Fowler</i> , wfowler@stanford.edu , Thornton 207. (650) 723-7306 <i>Sun Kim</i> , ksunkist@stanford.edu , Thornton 207. (650) 723-7306
Project Coaches:	<i>Karthik Manohar</i> , manohar@stanford.edu , Thornton 207. (650) 723-7306 <i>Jenny Wong</i> , cjwong1@stanford.edu , Thornton 207. (650) 723-7306
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: (tentative)	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 societal needs, user scenarios, customer values, functional realization, 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.

About the Active Learning (NEW for 2009!):

All homework assignments and some project evaluation tasks will utilize active learning techniques. For each assignment, we will pair two project teams. The two teams will meet (preferably in person, by telecom, etc., if necessary) to present each other assignments that focus on dfM methods and tools such as QFD. The teams will summarize, critique, and provide suggestions for the partner team's work. The teams will present the partner team's work (not their own work) at the active learning sessions, as well as incorporate the summary in the HW documents. The paring of the teams for active learning will rotate through ME317A&B for each homework / key project assignments.

Course Contents:

- Stanford dfM Process (*What is world class?*); Customer Value Chain Analysis (CVCA)
- Values, Scenarios, and Functions
- Customer Requirements Identification and Flowdown (QFD)
- Project Definition and Scenario Prototyping Rapidly
- Product Complexity and Cost Worth Analysis (CWA)
- Assembly Complexity
- Variety Complexity and Product Platforms
- Functional Realization and Parts Producibility
- Environmental Complexity
- Amorphous Products Design
- Failure Modes and Effects Analysis (FMEA)
- Design for Service Innovations
- Quality Scorecarding Framework
- Project Final Presentation

COURSE SCHEDULE**Meeting #1 (1/7 Wed): Stanford dfM Process (Ishii and the teaching team)**

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

Reading:

- 1.1 ME317 Reader: Ishii, K., "Introduction to Design for Manufacturability (dfM)"
- 1.2 ME317 Reader: Barkan, P., "A Road Map through the ME317 Product Development Process"
- 1.3 ME317 Reader: 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 1/8 17:00PST)
HW#1: Scenario Graph, CVCA (AL 1/21; Due 1/26)

Meeting #2 (1/12 Mon): Values, Scenarios, and Functions (Ishii/Kim)

- Identifying Scenarios (Who-What-Where-When), Scenario Graph
- Value Graph, Functional Analysis

Reading:

- 2.1 ME317 Reader: Kim, S., "Scenario-based Design"
- 2.2 ME317 Reader: Ishii, K., "Value Engineering (Value Identification and Functional Analysis)"
- 2.3 ME317 Reader: Ishii, K. and Mukherjee, S., "Development of AMX-4 Mobile Radiography System"
- 2.4 ME317 Reader: Ishii, K. and Thomas, P., "Redesign of Air-Cooled Generators"

On-campus students: Project offering meeting at 5:40pm-7:00pm, Thornton 102

Assignment:

- Sign up for Projects (Due 1/13 16:00 PST)
Project Teams formed 1/14

Meeting #3 (1/14 Wed): Customer Requirements Identification and Flowdown (Ishii)

- Eliciting and Organizing Voice of Customer
- Quality Function Deployment (QFD)

Reading:

- 3.1 ME317 Reader: Martin, M., "Voice of the Customer"
- 3.2 ME317 Reader: Martin, M., and Ishii, K., "Introduction to Quality Function Deployment"

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No Meeting 1/19 MLK Day Observed

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Meeting #4 (1/21 Wed): Project Definition and Scenario Prototyping Rapidly (Fowler)

- Project Financial Failure Modes (Renewed six questions)
- Project Assessment (Examples: Pochi-Tama, Buxi, Pilo, etc.)
- [ACTIVE LEARNING: Societal Need high level scenario, customer value chain](#)
- Scenario Prototyping Rapidly

Reading:

4.1 ME317 Reader: Beiter, K., Ishii, K., Karandikar, H. "Customer Requirements Management: Methodology Selection and Deployment Guide"

Assignment:

HW#2: Quality Function Deployment (AL 1/28, Due 2/4)

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Meeting #5 (1/26 Mon): Product Complexity and Cost Worth Analysis (Ishii)

- Identification of cost drivers
- Cost sensitivities

Reading:

5.1 ME317 Reader: Ishii, K. and Kmenta, S., "Life-cycle Cost Drivers and Functional Worth"

5.2 ME317 Reader: Barkan, P. and Ishii, K., "Design Issues Related to Product Cost and Product Profitability"

Due:

HW#1: Scenario Graph, CVCA

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Meeting #6 (1/28 Wed): Assembly Complexity (Ishii)

- Design for Assembly
- Assembly Quality Evaluation
- [ACTIVE LEARNING: QFD](#)

Reading:

6.1 ME317 Reader: Ishii, K. and Kmenta, S., "Introduction to Design For Assembly (dfA)"

6.2 Cheldelin, B. and Ishii, K. "Mixed Model Assembly: An Approach to Prevent Human Errors"

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Meeting #7 (2/2 Mon): Variety Complexity and Product Platforms (Ishii)

- Design for Variety
- Platform Architecture

Reading:

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

8.2 Yang, T. "Platform Design"

Assignment:

HW#3: Complexity (AL 2/9, Due 2/18)

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Meeting #8 (2/4 Wed): Functional Realization and Parts Producibility (Beiter)

- Complexity in function realization
- Material and Process Selection, Producibility
- What's a part for an amorphous sytesm? (e.g. software)

Reading:

11.1 To be announced

Due:

HW#2: Quality Function Deployment
 Project Abstract

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Meeting #9 (2/9 Mon): Environmental Complexity (Ishii)

- Design for Environment
- **ACTIVE LEARNING: Complexity**

Reading:

9.1 Gheorghe, R and Ishii, K. (2007) "Eco-Design Value Alignment-Keys to Success,"

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Meeting #10 (2/11 Wed): Project Status Report

- **Mid Quarter Project Presentation**
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No Meeting 2/16 Presidents Day Observed

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Meeting #11 (2/18 Wed): Amorphous Products Design (Beiter)

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

Reading:

11.1 To be announced

Due:

HW#3: Complexity

Assignment:

HW#4: FMEA, Complexity-Worth Analysis (AL3/4, Due 3/2)

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Meeting #12 (2/23 Mon) Failure Modes and Effects Analysis (Ishii)

- Introduction to Ownership Quality
- Failure Modes and Effects Analysis

Reading:

12.1 ME317 Reader: Kmenta, S., and Ishii, K., "Failure Modes and Effects Analysis"

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Meeting #13 (2/25 Wed): Design for Service Innovation (Ishii/Kim)

- Serviceability Design
- Service as a Business

Reading:

14.1 ME317 Reader: Kmenta, S. and Ishii, K., "Design for Serviceability"

14.2 ME317 Reader: Kim, S. and Ishii, K., "Scenario-based Design"

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Meeting #14 (3/2 Mon): Quality Scorecarding Framework (Ishii)

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

Reading:

15.1 ME317 Reader: Chao, L. and Ishii, K., "XYY Robotics Nina Project"

Due:

HW#4: FMEA, Complexity-Worth Analysis (AL3/4, Due 3/2)

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Meeting #15 (3/4 Wed): Worth and Complexity (???)

- More on Complexity-Worth Analysis and its various uses
- **ACTIVE LEARNING: Life-cycle Worth and Complexity (Use FMEA)**

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Meeting #16 (3/9 Mon): Concept Generation (CRITICAL TO PROJECT, ATTENDANCE MANDATORY)

- Concept Generation, Functional and Morphological Design

No Reading: End-of-quarter eye relief

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Meeting #17 (3/11 Wed):End-Quarter Presentation 4:15-7:00pm

- [End-Quarter Presentation](#)
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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. Concept Generation (Lecture at the end of ME317A)
 2. Worth Feasibility Evaluation
 3. Concept Selection (Pugh Method)
 4. Quality by Design: Six Sigma Concept and Robust Design Basics
 5. Robust Design: Conceptual / DoE-based Parameter
 6. Poka Yoke: Mistake Proofing
 7. Advanced Robust Design: Modeling and Optimization (Streamline?)
 8. Decision Analytical Scorecarding
 9. Showcasing the proposed innovation
 10. Tracking the dfM Process and Reflection (Ah Hah, Oops, and Eureka)
 11. Towards Advanced dfM
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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

- HW#1: Scenario Graph, Customer Value Chain analysis
- HW#2: Quality Function Deployment
- HW#3: Complexity
- HW#2: FMEA, Complexity-Worth Analysis

3. Due Dates

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

4. Handing in your Assignment.

On campus students should submit their homework in class or to the Thornton 207 by 16:15 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

1/12/2009 (Mon)	Project Offering Meeting
1/14/2009 (Wed)	Project Teams Announced
2/11/2009 (Wed)	Project Status Presentation
3/11/2009 (Wed)	ME317A Final Presentation (1615-1930PDT)
3/12/2009 (Thurs)	ME317A Final Report (by 1600PDT)
6/1/2009 (Mon)	ME317A&B Overall Final Report (by 1600PDT, no exception)
6/3/2009 (Wed)	ME317A&B Overall Final Presentation (1615 – 1830PDT)