

MASTER SCHEDULE

week	Tuesday	Thursday
1	Class 1 February 3 Introduction and Design Thinking <i>submit 2 opportunities (by Wednesday 11pm)</i>	Class 2 February 5 Systematic Product Design Process <i>rate 50 opportunities (by Friday 11pm)</i>
2	Class 3 February 10 Customer Needs and Real-Win-Worth-it <i>assigned groups explore top opportunities</i>	Class 4 February 12 Project Selection <i>present and select opportunities to form project teams</i>
3	February 17 No Class — Presidents Day (MIT's Monday classes are held)	Class 5 February 19 Product Specifications and User Interface <i>mission statement</i>
4	Class 6 February 24 Creativity and Concept Generation	Class 7 February 26 Prototyping <i>customer needs and competitive analysis</i>
5	Class 8 March 3 Concept Selection	Class 9 March 5 Industrial Design <i>concepts, specs, and patent search</i>
6	Class 10 March 10 Experience and Service Design Report 1	Class 11 March 12 Concept Model Design Review <i>concept models, selection, and uncertainties</i>
7	No Classes — SIP Week	
8	No Classes — Spring Break	
9	Class 12 March 31 Design for Environmental Sustainability	Class 13 April 2 Intellectual Property Peer Eval 1 <i>project timing and risk plan</i>
10	Class 14 April 7 Product Architecture and Modularity	Class 15 April 9 Product Testing and Validation <i>final specifications</i>
11	Class 16 April 14 Product Development Economics	Class 17 April 16 Guest Lecture – Brian Matt, Altitude <i>testing and production plans</i>
12	April 21 No Class — Patriots Day	Class 18 April 23 Detail Design Review <i>life cycle assessment and patent review</i>
13	Class 19 April 28 Guest Lecture – Jim Christian, AvaTech	Class 20 April 30 Product Management Report 2 <i>financial model and business plan</i>
14	Class 21 May 5 Guest Lecture – Jon Hirschtick, Onshape	Class 22 May 7 Prepare for Design Review <i>alpha prototype</i>
	Final Design Review <i>final presentation and prototype demonstration</i>	9am - 4pm, location RISD, Sat., May 9
15	Class 23 May 12 Feedback and Evaluations Peer Eval 2	Class 24 May 14 No Class – This time is used on May 9

Details are found in the following sections: General Information, Class Schedule, and Project Schedule.

GENERAL INFORMATION

Course Description

This class teaches modern tools and methods for product design and development. The cornerstone is a project in which teams of management, engineering, and industrial design students conceive, design, and prototype a physical product. The class is primarily intended for Sloan MBA students (particularly the Entrepreneurship and Innovation track and the Leaders for Global Operations program) and for MIT engineering graduate students (particularly mechanical engineering, manufacturing, and engineering systems masters programs). The course is jointly taught with Rhode Island School of Design for RISD industrial design students as a senior studio.

Teaching Staff

Prof. Steven Eppinger, MIT Room E62-468, eppinger@mit.edu

Prof. Maria Yang, MIT Room 3-449, mcyang@mit.edu

Prof. Matt Kressy, RISD, mkressy@risd.edu

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TAs: Olivia Gao, Phil Gara, and Brandon Hopkins, pdd-TA@mit.edu

Enrollment Policy

We need to balance the engineering, business, and design skills in the class. To do so, Sloan, LGO, and SDM students must enroll using SloanBid. Engineering students should preregister by January 1 and will be informed if their enrollment is accepted. RISD students enroll with permission of Prof. Kressy.

Class Meetings

Tuesdays and Thursdays 1:00pm to 4:00pm, MIT Room E62-276

- The first half of each class session will generally be in lecture and discussion format.
- The second half will generally be used for project team meetings and consultation.

Stellar Site

Course materials are found on: <http://stellar.mit.edu/S/course/15/sp15/15.783>

Office Hours

Course faculty are available to meet students and teams during the second half of class.

Learning Objectives

The focus of Product Design and Development is integration of the marketing, design, engineering, and operations functions of the firm in creating a new product. The course is intended to provide you with the following benefits:

- Competence with a set of tools and methods for product design and development.
- Confidence in your own abilities to create a new product.
- Awareness of the role of multiple functions in creating a new product (e.g., strategy, product management, marketing, finance, industrial design, engineering, production, supply chain, environmental safety, project management).
- Ability to coordinate multiple, interdisciplinary tasks to achieve a common objective.
- Reinforcement of specific knowledge from other courses through practice and reflection in an action-oriented setting.

Workload

This is a 12-unit MIT graduate course. Accordingly, the course has been designed to demand approximately 12 hours per week of your time, on average, over the semester. You are expected to prepare for and attend all class and studio sessions, complete the assignments, and contribute regularly and substantially to your team project. Experience with project-based courses is that some students develop high expectations for their projects and devote substantially more time than is required by the instructors. We applaud this enthusiasm, but we will not penalize students who establish a 12-hour per week average time constraint for their efforts. Workload is fairly smooth, with increased project effort toward the end balanced by less class preparation.

Classroom Standards

We adhere to MIT Sloan Professional Standards for academic conduct and academic integrity. (See link to standards on Stellar.) This means coming to class on time (by 1:05pm), no mobile phone or laptop computer usage during class presentations and discussions, and conducting one conversation at a time. Please use your name card every day in class. If you do not have a name card, ask the TAs.

Academic Integrity

Full group and class collaboration on all aspects of this course is highly encouraged. It is almost impossible to share too much information in product development teams. However, when writing and presenting material (ideas, data, graphics, photos, text, etc.) based on the work of others, it is necessary to cite such sources appropriately.

Class Preparation and Participation

Reading assignments for each class session are given in the Class Schedule section of this syllabus. You are expected to come to class prepared to discuss the readings and the suggested questions. Your individual class participation grade will be based upon your in-class remarks during discussions. Using your name card is essential to grading.

Reading Materials

Most of the required readings are chapters in the textbook, PRODUCT DESIGN AND DEVELOPMENT (5th edition, 2012), written by Profs. Ulrich and Eppinger, available at the MIT Coop and through several online booksellers. The textbook is also on reserve at MIT Libraries. All of the other required and optional readings either are available online or through MIT Libraries database access and these are also posted for your convenience on Stellar. There is no reading packet to purchase at MIT CopyTech.

Grading

Students must register for the course for grades; the MIT P/D/F grading option is not allowed for this course. Your course grade will be determined as follows:

- 10% quality of your individual product opportunity proposals and participation in rating
- 10% quality of your small-group exploration of top product opportunity proposals
- 20% quality of your personal preparation and participation in class
- 15% quality of your team's work on (two) project reports
- 15% quality of your team's work on concept design and detail design reviews
- 25% quality of your team's work presented in the final design review
- 5% quality of your peer evaluation ratings given by your team members

Projects

Your challenge in the project portion of this course is to design a new product and to produce a prototype version of it. The goal of this exercise is to learn principles and methods of product development in a realistic context. Most product development professionals work under tremendous time pressure and do not have sufficient opportunity to reflect on the development process. In this course, the project stress level will be low enough that there will be time to experiment and learn. Project ideas come from the students in the class plus one or more sponsored project opportunities. We will be using an internet-based idea tournament to collect and rate potential project opportunities. The project downselection process will be done in two stages; first the top ~30 rated opportunities will be explored in small groups for a week, and then the most promising ~12 opportunities will be used to form project teams for the remainder of the semester. Guidelines for reasonable projects are given below.

Sponsored Projects

This course is generously supported by a small number of sponsors (mostly alumni of this class from earlier years). In addition to providing the funds to cover project expenses, sponsors may suggest one or more project opportunities for your consideration. If you choose to work on one of the sponsored projects, you will benefit from additional interaction with the project sponsors.

Project Teams

In the second week of the course, we will form roughly 12 project teams on the basis of student interest in the top product opportunities explored. (See the Project Schedule for details.) Teams will consist of about eight students. Once you are assigned to a project team, we expect you to stay in the course for the entire term. The drop-or-commit date is therefore before Class 4.

Project Reviews

We will conduct two informal design reviews during the semester and one formal final project review at the end of the semester. In addition to faculty, TAs, and your peers, we will invite outside product development experts to participate in the final review.

Project Resources

The TAs maintain a "Resource Wiki" on Stellar where we list a variety of resources that may be helpful for your project work. This includes available machine shops and other facilities on MIT and RISD campuses, suppliers of materials and services, and other helpful resources. Of course, this is a collaborative effort that will benefit from input by all students, TAs, and faculty.

Project Expenses

We have a limited amount of funds to reimburse students' out-of-pocket expenses related to the course projects. Each team will be allocated a budget of \$1000. If your project requires additional expenditures, your team is expected to cover these expenses personally. Instructions and forms for reimbursement are on Stellar. Note in particular that MIT will not reimburse for sales tax, so you may need to provide MIT's tax exemption number to vendors when you make purchases. Please contact your team's TA if you have questions about allowable expenses or reimbursement procedures.

Intellectual Property Rights

The student teams will be able to retain the rights to any inventions they develop in this course. If a team should decide to pursue a patent, they may do this on their own. Alternatively (and this is strongly recommended for sponsored projects), the team can “disclose” their invention with MIT, which may be interested in patenting it, in exchange for a portion of any licensing royalties. Feel free to speak with the course faculty about these and other options. Teams should spend some time during an early meeting agreeing in advance on how to distribute any economic rewards arising from the intellectual property you create. Be sure to keep dated records showing the evolution of your ideas.

Project Themes

In recent years we have had success with class projects focusing on “sustainable design”. Accordingly, you are strongly encouraged to propose project opportunities related to the following themes:

- Green living – products and services to reduce our personal environmental footprint
- Global health – solutions to improve health in the developing world
- Clean transportation – ways to reduce the energy demands of transportation

Guidelines for Projects

While special cases will be considered, you are strongly encouraged to propose and choose a project satisfying all of the following constraints:

- There should be a demonstrable market for the product. One good way to verify a market need is to identify existing products that attempt to meet the need. Your product need not be a variant of an existing product, but the market need addressed by your product should be clearly evident. The product does not need to have a tremendous economic potential, but should at least be an attractive opportunity for a new venture or an established firm (or NGO) with related products and/or skills.
- Most products developed in this class are material goods and not services. While just about all of the ideas in the course apply to services and software products (for example, *customer needs* and *product architecture*), we have found that having most or all teams develop physical products gives the class a common experience and timeline we can use as a basis for class discussions. Nevertheless, we welcome project proposals from students interested in developing software, services, mobile apps, and internet-based enterprises.
- The product should have a high likelihood of containing fewer than 10 parts. Although you cannot anticipate the design details, it is easy to anticipate that an electric drill will have more than 10 parts and that a garlic press can have fewer than 10.
- You should be confident of being able to prototype the product for less than \$1000. For example, a razor like Gillette’s Fusion may have about 10 parts, but would require tens of thousands of dollars to create a geometrically accurate, functional prototype.
- The product should require no basic technological breakthroughs. (Yes, a more compact airbag would be a nice, but can you do it without inventing a new chemical?) You do not have time to deal with large technological uncertainties.
- You should have access to more than five potential users of the product (more than 20 would be nice). For example, you would have great difficulty researching

agricultural irrigation systems without leaving Cambridge or Providence, so you better have a plan for making effective contact with customers – ideally in person.

A few more hints:

- Save any highly proprietary ideas for another context; we will be quite open in discussing the projects in class and do not wish to be constrained by proprietary information.
- Most successful projects tend to have at least one team member with strong personal interest in the target market.
- It is really nice to have a connection to a commercial venture that may be interested in the product. (One group eventually signed a licensing agreement with a major retailer with which they had made contact during the first week of the course. The product they developed became a commercial success.)
- Most products are really not very well designed. This is evidenced by the strikingly poor quality of common consumer products (utility knives, garlic presses, and ice cream scoops, for example). The experience in this class is that if you pick almost any product satisfying the above project guidelines, you will be able to develop a product that is superior to most competitors on the market. A book titled *THE DESIGN OF EVERYDAY THINGS* by Don Norman (revised edition, MIT Press, 2014) discusses good and bad examples and provides principles and guidelines for good design. (See also his other books.)
- Just because you have used a lousy product, doesn't mean that a better one doesn't already exist. Do some thorough research to identify competitive products and solutions.

Some Project Examples from Previous Classes

- clipboard for disabled persons
- beverage holder for sail boats
- stripping basket for fly fishing
- rowing foot stretcher for crew shells
- beer bottle capper for home brewers
- grocery bag carrier for urban shoppers
- brake for in-line skates
- vaccine transport system
- ventilator for neonatal infants
- lightweight furniture for backpackers
- canteen for in-line skaters
- book bag for college students
- portable sharpener for ice skates
- laser level for carpenters
- sugar dispenser for coffee shops
- clamp for theatrical lighting
- tripod for birders
- eco-friendly beverage packaging
- rural water transportation device
- bike lock with one-hand operation

Project Examples



Avalanche Detection System: Probe measures the snow density profile, which is displayed over the depth of the snow pack.



Paint Can: Plastic paint container, twist to open, easy-to-pour gallon. Sold with Dutch Boy and Sherwin Williams brand paints.



Ice Cream Scoop: Super-cooled salt solution inside the handle heats up at the touch of a button, recharges in the dishwasher.



Drink Rimmer: Handheld device places salt or cocktail spices around the rim of a cocktail glass. Sold as the Barmaid product line.



Easy Bike Lock: Remove from frame, lock to pole, unlock, and mount to frame – all with a one-handed operation.



Infant Phototherapy: Low-cost medical device for newborn infants requiring therapeutic light treatment for jaundice.

CLASS SCHEDULE**Class 1****Introduction and Design Thinking**

Tuesday, February 3

We will discuss the methods and processes used for product development. We will also discuss course logistics, projects, and your first assignment.

- Read this course syllabus completely.
- Look at some of the *BusinessWeek* [online slideshows](#) of notable recent innovations, and also see the [RedDot Product Design Award winners](#).
- Read PDD CHAPTER 3: OPPORTUNITY IDENTIFICATION.
- [Optional] This is an appropriate time to read the first two chapters of the textbook: PDD CHAPTER 1: INTRODUCTION; and PDD CHAPTER 2: DEVELOPMENT PROCESSES AND ORGANIZATIONS; however we will primarily be discussing PDD CHAPTER 3 in class.

Class 2**Systematic Product Design Process**

Thursday, February 5

We will discuss the process of systematic innovation and design thinking skills applied to product development. We will also learn about IDEO, perhaps the world's most successful product design consultancy. Some of you have read a case about IDEO, and discussed it in another class. We will not discuss a case. Instead, we will consider IDEO as an example of a highly innovative PD process following the systematic methods we teach in this class. Please do the following to prepare for our discussion:

- View the [video](#) of the 2013 interview of IDEO founder David Kelley from *CBS News 60 Minutes*. (13 min)
- [Optional] Read the article DESIGN THINKING, by Tim Brown, CEO of IDEO (*HBR*, 2008).

Class 3**Customer Needs and Real-Win-Worth-it**

Tuesday, February 10

We will discuss methods for gathering, organizing, and utilizing the "voice of the customer". We will also discuss the Real-Win-Worth-it method (from PDD CHAPTER 3, assigned earlier) for evaluating product development opportunities.

- Read PDD CHAPTER 5: IDENTIFYING CUSTOMER NEEDS.
- Review the section about Real-Win-Worth-it in PDD CHAPTER 3: OPPORTUNITY IDENTIFICATION, which you read for Class 1.
- [Optional] Read two *BusinessWeek* articles with opposing views about listening to customers at [Lego](#) and [Zara](#), L EGO IS FOR GIRLS (Dec 2011) and ZARA FOLLOWS SHOPPERS INTO THE BEDROOM (Dec 2014).

Class 4**Project Selection**

Thursday, February 12

You will present the project opportunities you have been exploring in small groups this week. For more details, refer to the assignment in the Project Schedule. After the presentations, you will submit your project preferences in order to form the teams.

No Class**Presidents Day Holiday**

Tuesday, February 17

Due to the Presidents Day holiday, MIT's Monday classes are held on Tuesday.

Class 5**Product Specifications and User Interface**

Thursday, February 19

We will discuss methods for translating customer needs into measurable specifications. We will also have a guest speaker to discuss how user interface and user experience (UI/UX) are designed to create products with winning "look & feel".

- Read PDD CHAPTER 6: PRODUCT SPECIFICATIONS.
- Complete Exercise 1 and be prepared to discuss the Questions at the end of the chapter.
- [Optional] A good reading about target costing is DEVELOP PROFITABLE NEW PRODUCTS WITH TARGET COSTING, by Cooper and Slagmulder (*SMR*, 1999).
- [Optional] Read about UI/UX design in the Apple Watch Human Interface [Guidelines](#).

Class 6**Creativity and Concept Generation**

Tuesday, February 24

We will be discussing methods for developing a wide range of innovative solutions and product concepts. We will conduct an exercise in class to develop advanced creativity skills, and we will discuss Questions 1 and 2 from the end of the chapter.

- Read PDD CHAPTER 7: CONCEPT GENERATION.
- [Optional] View some of the [TED talks](#) on their creativity playlist.

Class 7**Prototyping**

Thursday, February 26

We will discuss the role of prototypes, models, simulation, and analysis. Please be prepared to discuss and critique the prototyping experiences and plans for your project.

- Read PDD CHAPTER 14: PROTOTYPING.
- Consider the Questions at the end of the chapter.
- [Optional] Read Gershenfeld's article about 3D printing and the democratization of custom fabrication, HOW TO MAKE ALMOST ANYTHING (*Foreign Affairs*, 2012).
- [Optional] Read THE EFFECT OF "FRONT-LOADING" PROBLEM-SOLVING ON PRODUCT DEVELOPMENT PERFORMANCE by Thomke and Fujimoto (*JPIM*, 2000).

Class 8**Concept Selection**

Tuesday, March 3

We will discuss the effective use of screening and scoring matrices for downselection. We will conduct an exercise in class to illustrate the concept selection process.

- Read PDD CHAPTER 8: CONCEPT SELECTION.
- Consider the Questions at the end of the chapter.

Class 9**Industrial Design**

Thursday, March 5

We will have a discussion about the role of industrial design, aesthetics, and user interface design in successful product development.

- Read PDD CHAPTER 11: INDUSTRIAL DESIGN.
- Be prepared to discuss the three Questions at the end of the chapter.

- [Optional] View the video of industrial designer Yves Bahar's [TED talk](#) about his work at fuseproject (18 min).

Class 10**Experience and Service Design**

Tuesday, March 10

This class session is about the application of PD methods to design of services and customer experiences in general. We will discuss a new (draft) chapter of the PDD text.

- Read the PDD 6TH EDITION DRAFT CHAPTER: DESIGN OF SERVICES, which presents a way to think about service design along with the Zipcar example.
- [Optional] Read Don Norman's [essay](#) about experience design WORDS MATTER. TALK ABOUT PEOPLE: NOT CUSTOMERS, NOT CONSUMERS, NOT USERS

Class 11**Concept Model Design Review**

Thursday, March 12

Each team will present to the class their market opportunity, selected concept, and proof-of-concept models. For more details, refer to the Project Schedule.

No Class**SIP Week and Spring Break**

March 16 to March 27

Class 12**Design for Environmental Sustainability**

Tuesday, March 30

This session will explore how to understand and reduce the environmental impact of products and services.

- Read PDD CHAPTER 12: DESIGN FOR ENVIRONMENT.
- Think about the products and services you use, and try to identify one that has clear environmental benefits compared to its alternatives.

Class 13**Intellectual Property**

Thursday, April 2

We will discuss various forms of intellectual property and how to apply for a patent.

- Read PDD CHAPTER 16: PATENTS AND INTELLECTUAL PROPERTY.
- Find a patent number on a product that interests you. Then locate a copy of the patent (text and illustrations) and read it. You may research patent information on the internet at [US Patent and Trademark Office](#) or [Google patents](#).

Class 14**Product Architecture and Modularity**

Tuesday, April 7

We will discuss the importance of product architecture and the use of modular design.

- Read PDD CHAPTER 10: PRODUCT ARCHITECTURE.
- Complete one of the Exercises at the end of the chapter.
- [Optional] Two articles illustrating recent research around product architecture are IMPROVING AN EXISTING PRODUCT FAMILY BASED ON COMMONALITY/DIVERSITY, MODULARITY, AND COST by Alizon, et al. (*Design Studies*, 2007), and PRODUCT PLATFORM DESIGN AND CUSTOMIZATION, by Simpson (*AIEDAM*, 2004).

Class 15**Product Testing and Validation**

Thursday, April 9

We will discuss risk management through product testing in various forms. We will

explore prioritization of risks to find the fastest route to failure (or validation). We will discuss concept testing (early), product validation (pre-launch), and A/B testing (post launch).

- Read PDD CHAPTER 9: CONCEPT TESTING.
- Read TECHNOLOGY READINESS LEVELS by Mankins (NASA, 1995), a brief white paper which summarizes the TRL definitions developed by NASA and adopted by many companies to assess project technical risks.
- [Optional] Read about collective commitment, an interesting approach to market and financial risks, described in REDUCING THE RISKS OF NEW PRODUCT DEVELOPMENT by Ogawa and Piller (SMR, 2006).

Class 16**Product Development Economics**

Tuesday, April 14

This class session is about analysis of product development projects in financial terms.

- Read PDD CHAPTER 17: PRODUCT DEVELOPMENT ECONOMICS.
- Consider the Questions at the end of the chapter.

Class 17**Guest Lecture – Brian Matt, Altitude**

Thursday, April 16

Our guest is Brian Matt, founder and Chairman of [Altitude](#) – a product and service experience design consultancy which has designed award-winning sports equipment, medical devices, consumer products, and healthful experiences.

No Class**Patriots Day Holiday**

Tuesday, April 21

MIT takes a two-day holiday.

Class 18**Detail Design Review**

Thursday, April 23

Each team will present to the class their product opportunity, selected concept, proof-of-concept model(s), and plans for completion of the project. For more details, refer to the Project Schedule.

Class 19**Guest Lecture – Jim Christian, AvaTech**

Tuesday, April 28

Our guest is Jim Christian, co-founder and Lead Product Designer at [AvaTech](#) – an avalanche safety business that grew out of a 2013 PDD class project.

- No readings today.

Class 20**Product Management**

Thursday, April 30

In this class, we will discuss the product management function and other leadership roles in successful design and product development.

- No readings today.

Class 21**Guest Lecture – Jon Hirschtick, Onshape**

Tuesday, May 5

Our guest is Jon Hirschtick, founder and CEO of [Onshape](#) (2013), founder of

SolidWorks (1993), and MIT alumnus (1983). Jon is a renowned visionary in the world of design whose innovations in 3D CAD are used daily PDD students and by millions of designers around the world.

- No readings today.

Class 22**Prepare for Design Review**

Thursday, May 7

Use this time to work with your teams in preparation for the final design review.

Special Class Session**Final Design Review**

Saturday, May 9

Final project presentations will be held approximately from 9:00am to 4:00pm at RISD. This is a mandatory session and you are expected to attend the full day. The presentations will be worth it! For more details, refer to the Project Schedule.

Class 23**Feedback and Evaluations**

Tuesday, May 12

In this final session, we will discuss your PDD course experience over refreshments, and you will complete the course evaluations and feedback forms. Please bring your laptop or tablet computer for the online evaluations. You must make alternate arrangements with the TAs to complete the course evaluations if you cannot attend this class session.

Class 24**No Class**

Thursday, May 14

In lieu of this class, we will hold the project presentations on Saturday.

PROJECT SCHEDULE

The product development process in the course includes assignments of four types:

1. **Individual Assignments** – Submit and rate project opportunities
2. **Small Group Assignment** – Explore and present one of the top 30 opportunities
3. **Project Team Assignments** – Weekly milestones, project reports, and reviews
4. **Peer Evaluations** – Rate your team members on their contributions to the project

Individual Assignment: Submit 2 Opportunities **Due Wednesday, Feb. 4, 11pm**

Using the Darwinator web site, submit two potential project opportunities. You should describe each one in terms of the market opportunity only; do not present your own specific ideas for addressing the opportunity at this point. Our focus at this point is on the market opportunity and not on solution concepts.

- Go to www.darwinator.com and log in to our tournament using the username and password sent to you during Class 1. (Save the email with the login information.) Contact TA [Phil Gara](#) with any Darwinator problems.
- Submit two project opportunities consisting of a brief, descriptive project title (2-4 words) and a short description of the market opportunity. Your description should include the following: documentation of the customer need, shortcomings of existing competitive products, and definition of the target market and its approximate size. Some example opportunity descriptions and brief video instructions are on Stellar.

Individual Assignment: Rate 50 Opportunities **Due Friday, Feb. 6, 11pm**

The Darwinator system will allow us to rate the opportunities submitted by the class.

- Return to our Darwinator tournament and rate at least 50 opportunities. This will ensure that every opportunity receives at least 25 ratings. Plan to spend a couple of hours completing this assignment, perhaps in two sittings. You may continue to rate as many opportunities as you like. Brief video instructions are on Stellar.
- After compiling the results, we will announce the top opportunities based on your ratings, and we will assign small groups to explore these opportunities.

Small Group Assignment: Explore and Present One Opportunity **Due Class 4**

- Using the Real-Win-Worth-it framework (PDD CHAPTER 3), assess the potential of the product/service opportunity. Identify the customer need and the potential value or benefit of a new product. Explain primary and secondary markets, competing products and/or services, and the potential to improve upon these.
- Prepare a 250-word, 1-page report of your findings.
- Present the opportunity to the class. Your 2-minute presentation should include approximately three slides: 1) Objectively explain the market need - Is it real?; 2) Show existing competitive products - Can we win?; 3) Give your honest assessment of the potential - Is it worth it? Note that the 180-second time constraint will be strictly enforced.
- One student in your group must upload your presentation slides (PPT or PDF) and report (PDF) to Stellar by noon before class.

Project Team Assignments: Milestones, Reports, Reviews, and Peer Evaluations

The product development process for this course follows a schedule of weekly milestones, two project reports, three project reviews, and two peer evaluations. The milestones represent the primary topics that you should be working on and prepared to discuss with the course faculty and TAs during the lab/studio session of the class; they

are not graded. Reports are to be turned in and reviews are held on the dates indicated here. Note that these assignments are intended to pace the development process for your product. There is virtually no slack in this schedule, and so weekly milestones should be completed during the scheduled week in order to maintain the project schedule. Each team member is expected to contribute substantially to the project work. Peer evaluations will be used to provide feedback to each other and to indicate to the faculty how the team is working.

Milestone 1: Mission Statement**Week 3**

- Develop a mission statement for your project team as described in PDD CHAPTER 4.
- Start conducting observational interviews with and collecting photos of customers in the use environment.

Milestone 2: Customer Needs and Competitive Analysis**Week 4**

- Based on interviews and/or surveys, develop an organized list of customer needs for your product as described in PDD CHAPTER 5.
- Identify products that you believe would be competitors in addressing your market opportunity. List key strengths and weaknesses of each.
- You do not need to conduct an importance survey. However, if you find the need to further understand preferences and tradeoffs, you should do so when appropriate.

Milestone 3: Concepts, Specs, and Patent Search**Week 5**

- Have each team member prepare two or more sketches and bullet-point descriptions of alternative concepts for your product. For each sketch, note which of the important customer needs it addresses and which it does not. Bring these to Class 8 for a concept generation exercise during the lab/studio session.
- To help explore the concept space, build 3D sketch models as discussed in Class 7.
- Choose a few (perhaps 3 or 4) critical customer needs from your list. For these critical few, prepare a list of the target specifications as defined in PDD CHAPTER 6, and provide justification for these targets.
- Conduct a preliminary patent search to identify patents most closely related to your product category and proposed solutions. Explain what you have learned from the search and how this might affect your approach to further development. You may research patent information at [US Patent and Trademark Office](#) or [Google patents](#).
- Use a concept selection matrix (screening or scoring) to select at most three concepts for further consideration.

Milestone 4: Concept Models, Selection, and Uncertainties**Week 6**

- Construct models to demonstrate and refine the most promising concept(s). These will be shown in the concept design review.
- Converge to a single concept if you have not done so already. Be prepared to explain your choice.
- Prepare a list of the key uncertainties or questions you still need to address to completely define your product. For each uncertainty, specify an associated plan of action (such as analysis, mock ups, interviews, experiments, etc.)
- There is much work to do for the next two milestones. Be sure to discuss plans for work that can be done to advance the design over Spring Break.

Report 1**Due Wednesday, March 11, 4pm**

- Prepare a report comprising the information and decisions contained in all of the milestones to date. This would include, for example, your lists of customer needs,

potential markets, competitive analysis, most promising concepts considered, status of concept selection, assessment of failure modes and risks, and your project plans for the remainder of the semester.

- As part of your report, include photos of your proof-of-concept models.
- Show a schedule in Gantt-chart form (see the example below) showing the plan of work to complete the project over the next two months. Include at least the following activities: detail design work, patent review, materials and components selection, vendor selection and interaction, procurement of materials and components, prototyping activities, testing, redesign, financial modeling, photography, completion of assignments, and preparation of the final presentation.
- Include in your report a short (less than one page) description of the process your group has followed in completing the project work to date. Explain how you are organizing the team and managing the work. Also comment on your process, including what has worked well and what has not.
- Include copies of the original opportunity proposal from the Darwinator site and the opportunity report completed by the small group, even though you likely have already modified the description of this opportunity in your team's mission statement.
- This report should be less than 15 pages, mostly charts and images. Include a cover sheet with your project title and a list of all the team members.
- Upload your report to Stellar by 4:00pm as a single PDF document in order to facilitate timely distribution, review, and grading by the course faculty and TAs. Use a descriptive file name, such as TeamNameReport1.pdf.

Review 1: Concept Model Design Review

Due Class 11

- Prepare a 5-minute presentation that includes your mission statement, critical customer needs, and the key innovation you expect to deliver new value to customers. Include a sketch of the selected concept or concepts.
- Show two or more physical models of the most promising product concept(s) and any key aspects of the concept that may be of concern. Models may be functional (working principles) or representational (looks like) – whatever is most helpful.
- Explain the key uncertainties you need to address to ensure a viable concept.

Milestone 5: Project Timing and Risk Plan

Week 9

- Summarize the progress and important decisions you have made since the previous assignment.
- Identify the remaining uncertainties and questions you still need to address in order to develop a working prototype. For each one, update your plan of action to address the risk of failure.
- Describe your prototyping plans. By this time, you should have a preliminary design of the alpha prototype and a bill of materials. You should be preparing to fabricate components and to place orders for any parts to be purchased.
- Update your project timing plan (the Gantt chart from Report 1).

Peer Evaluation 1

Due Friday, April 3, 4pm

You will receive an email from the online peer review system with a link and instructions to complete your evaluation of each member of your team. You will later receive a compilation of the feedback given by each of your team members.

Milestone 6: Final Specifications

Week 10

- Prepare an updated one-page description and sketch of your product concept.
- Create a 3D CAD model or assembly drawing of the alpha prototype you intend to

build, showing all the parts in their assembled positions. For examples, see [assembly drawings](#) and [CAD solid models](#) on Google Images. SolidWorks, Onshape, and other 3D-CAD software applications are available for your use. See Stellar for instructions to access the software. However, you may use any drawing package you like.

- Identify the critical-to-function (CTF) specifications and provide documentation showing how you arrived at these CTFs. (A stress calculation or other analysis may be needed, for example.)
- Update the bill of materials indicating whether the prototype parts will be purchased or fabricated, the material and fabrication process you have selected for each part, and a description of the assembly process.

Milestone 7: Testing and Production Plans

Week 11

- Explain your plans for testing the alpha prototype for both functionality and customer feedback.
- Make a drawing or sketch of the production version of the product. Describe the differences between the prototype you will build and the production product.
- Post the web resources and vendors you have found to be helpful onto the class wiki page.

Milestone 8: Life Cycle Assessment and Patent Review

Week 12

- Assess the environmental impact of your product (in production and use, not the prototype model) and any related services. Identify the sources of the greatest impacts and ways to potentially reduce these. If the product offers environmental benefits, conduct an analysis to compare it to competing products. Sustainable Minds online analysis software is available for this purpose (one license per team).
- Consider whether you have created a patentable innovation and whether you would like to protect this intellectual property. If you decide that there is nothing patentable, please explain this, and you do not need to complete the following.
- To prepare for a meeting with our patent attorney, submit the following background information for review: 1) Explain the product's market and core benefit to customers. 2) Conduct a patent search and provide references to any related US patents. 3) Describe what invention(s) within your product may be patentable, and provide a statement of the invention's novelty, utility, and non-obviousness.

Review 2: Detail Design Review

Due Class 18

- Prepare a 5-minute presentation of your progress toward the alpha prototype.
- Your presentation should include only a very brief description of the need and market. Explain the core benefit your product will provide and the innovation you have developed to deliver this benefit. A sketch of the product in use is often very helpful.
- Demonstrate a functional prototype.
- There is no need to summarize all of the work you have done to get to this point. Focus on the product today, not the development process.

Milestone 9: Financial Model and Business Plan

Week 13

- Prepare a financial model as described in PDD CHAPTER 17. Explain the scenario you are analyzing (startup activity, established manufacturer, non-profit organization, etc.). Document the assumptions you have made in the analysis. Note that you will require estimates for the production tooling and variable costs.
- Perform a sensitivity analysis of the key financial uncertainties you face.

Report 2**Due Friday, May 1, 4pm**

- Prepare a report comprising the information and decisions contained in all of the milestones to date. This would include any updates on the milestones from the first report as well as the newer ones.
- Include in your report a short (less than one page) description of the process your group has followed in completing the project work to date. Explain how you are organizing the team and managing the work. Also comment on what has worked well and what has not.
- This report should be less than 15 pages, mostly charts and images. Include a cover sheet with your project title and a list of all the team members.
- Upload your report to Stellar by 4:00pm as a single PDF document in order to facilitate timely distribution, review, and grading by the course faculty and TAs. Use a descriptive file name, such as TeamNameReport2.pdf.

Milestone 10: Alpha Prototype**Week 14**

- By this time, you should be testing your product prototype for performance and customer feedback.
- Show your prototype to the course faculty and TAs this week to get some feedback.

Review 3: Final Design Review**Due Saturday May 9**

- Prepare a 15-minute presentation describing and demonstrating your product. Your presentation should concentrate on the product itself, although you may wish to emphasize any particularly impressive portions of your development process. An effective presentation includes color photographs or video presentation along with a live display of the hardware. This presentation should be of the quality you would make to convince a top management group to purchase the rights to your product or to fund its final development and launch. In addition to your classmates, a panel of experts will observe your presentations and evaluate the projects. Be prepared to answer questions about all aspects of your project.
- [Optional] Create and demonstrate a web site designed to promote your product.
- Submit the slide presentation (and link to the optional web site).
- Submit several high-quality digital photos of the prototype (.jpg with at least 1500 pixels on longest side). Be sure to include photos of the product in use. Two good tutorials on taking great product photos are on [wikiHow](#) and [Wix](#).

Peer Evaluation 2**Due Class 23**

You will receive an email from the online peer review system with a link and instructions to complete your evaluation of each member of your team. You will later receive a compilation of the feedback given by each of your team members.

Project Timeline

Here is a Gantt chart showing the timing of various project activities and milestones during the project.

