EE 4BI6
Capstone Design Course Outline

- Objectives of the course
- Guiding design principles
- Requirements from students
- Design platforms and technologies supplied by department
- Timelines and credit
- Role of instructor

Objectives of Course

- Give students experience in organizing and working as a team
- Give students an opportunity to select and develop their own project
- Give students an opportunity to utilize skills and knowledge developed in prior courses
- Give students an opportunity to learn and utilize new technologies required for their project (e.g. wireless interfaces)

Guiding Design Principles

- Treat project as an industrial design (time and money constraints)
- Always keep in mind the problem (or need) you are solving
- In designing your product keep in mind feasibility, sustainability and patient or subject safety

Requirements from Students

- Form your team
- Select and research a problem or need in medicine or everyday life which can be addressed by your design
- Develop and submit a detailed project proposal by mid October
- Present proposal and initial development by December
- Present and demonstrate final project at Poster day in early April
- Submit final Project Report before end of exam period
- Meet regularly with course instructor to present progress and problem solve

Design Platforms and Technologies Supplied by Department

- Biomedical undergraduate lab ITB 153
- Oscilloscopes, function generators, powered breadboards and analog design boards (EE 4BD4)
- National Instruments laboratory computer interfaces and Labview virtual instrumentation software
- General electronic parts (op amps, instrumentation amps, resistors, capacitors, electrodes and leads)

Timelines and Credit

- Project Proposal: October 17, 2016 50%
- Group progress presentation to class: week of Nov 28, 2016 plus 25%
- Group Progress demonstrated during team meetings and lab demonstration 25%
- Presentation and demonstration (including poster: first week of April 2017 60%
- Final Report and demonstration to instructor: Before end of exams 2017 40%

Role of Instructor

- Determine feasibility of project and help develop proposal
- Suggest projects and approaches when required
- Give continuous advice and evaluations of progress
- Provide detailed technical input when appropriate
- Act as mentor

Successful Product Development

- Product Quality
- Product Cost (capital equipment, tooling, incremental costs)
- Development Time (response to market need, time before deliver or economic return)
- Development Cost (Salaries +other costs)
- Development Capability (developed design expertise)
- Success depends on high performance in each category

In Industry Who Designs Products?

- Marketing (assess customer needs, target price, promote)
- Design (technical aspects)
- Manufacturing (tooling up, estimate costs)

The Team

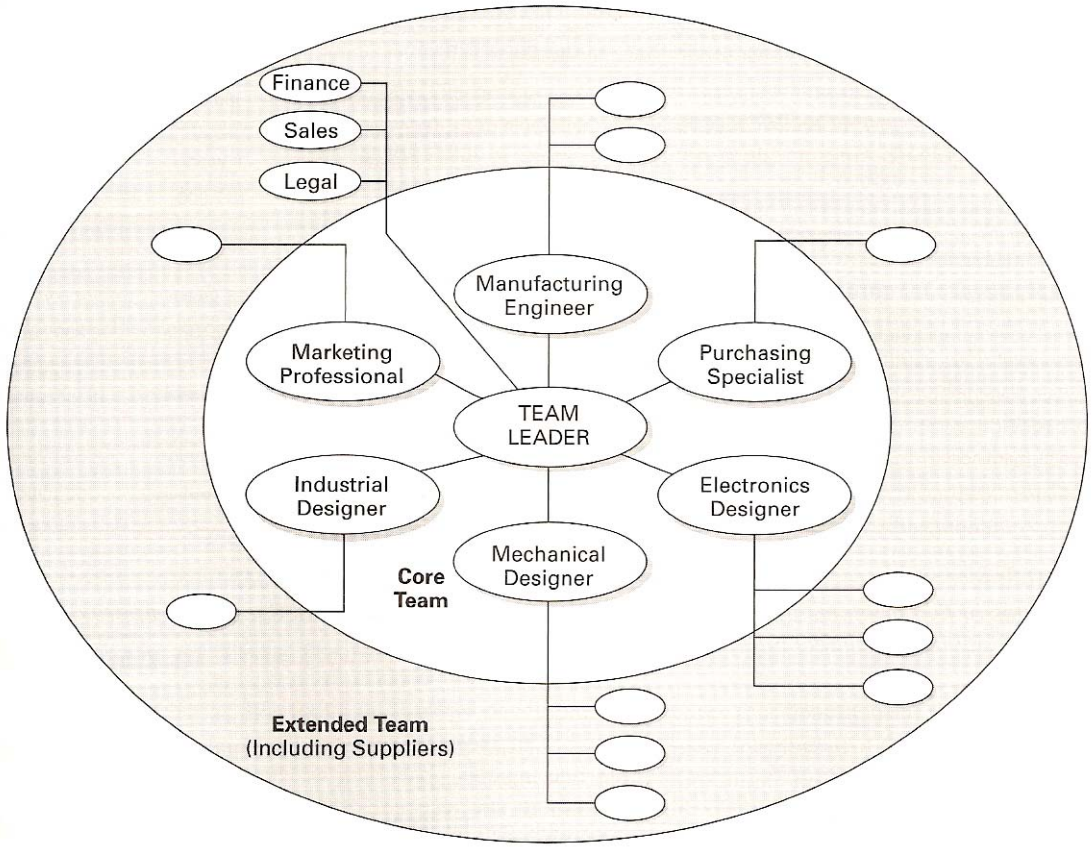


EXHIBIT 1–2

The composition of a product development team for an electromechanical product of modest complexity.

Cost of Development

	Stanley Tools Jobmaster Screwdriver	Rollerblade In-Line Skate	Hewlett-Packard DeskJet Printer	Volkswagen New Beetle Automobile	Boeing 777 Airplane
Annual production volume	100,000 units/year	100,000 units/year	4 million units/year	100,000 units/year	50 units/year
Sales lifetime	40 years	3 years	2 years	6 years	30 years
Sales price	$3	$200	$300	$17,000	$130 million
Number of unique parts (part numbers)	3 parts	35 parts	200 parts	10,000 parts	130,000 parts
Development time	1 year	2 years	1.5 years	3.5 years	4.5 years
Internal development team (peak size)	3 people	5 people	100 people	800 people	6,800 people
External development team (peak size)	3 people	10 people	75 people	800 people	10,000 people
Development cost	$150,000	$750,000	$50 million	$400 million	$3 billion
Production investment	$150,000	$1 million	$25 million	$500 million	$3 billion

EXHIBIT 1–3

Attributes of five products and their associated development efforts. All figures are approximate, based on publicly available information and company sources.

Considerations in Development

- Tradeoffs (features vs cost)
- Dynamics (Changing market tastes, technology)
- Details (minor details such as snap vs screws)
- Time Pressure (need to be made quickly and with minimum information)
- Economics

Appeal to Engineers

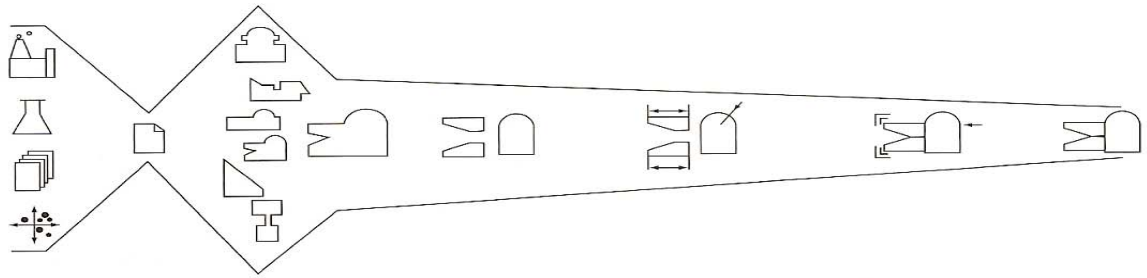
- Creativity
- Satisfying Societal or Individual Needs
- Team Diversity
- Team Spirit
- Financial Opportunities

Organizational Problems

- Lack of Empowerment (interference by managers who don't understand team's thinking)
- Functional Allegiances Transcending Project Goals (different disciplines promote own goals at expense of project goals)
- Inadequate Resources (equipment, personnel, money)
- Lack of Cross Functional Representation on Project Team (essential disciplines are not present for team discussions)

Generic Development Process

- Sequence of steps or activities to conceive, design and commercialize product
- Can be highly structured or ad hoc
- Well defined process aids in:
- Quality Assurance
- Coordination
- Planning
- Management
- Improvement



Planning	Concept Development	System-Level Design	Detail Design	Testing and Refinement	Production Ramp-Up
Marketing • Articulate market opportunity. • Define market segments.	• Collect customer needs. • Identify lead users. • Identify competitive products.	• Develop plan for product options and extended product family.	• Develop marketing plan.	• Develop promotion and launch materials. • Facilitate field testing.	• Place early production with key customers.
Design • Consider product platform and architecture. • Assess new technologies.	• Investigate feasibility of product concepts. • Develop industrial design concepts. • Build and test experimental prototypes.	• Generate alternative product architectures. • Define major sub-systems and interfaces. • Refine industrial design.	• Define part geometry. • Choose materials. • Assign tolerances. • Complete industrial design control documentation.	• Reliability testing. • Life testing. • Performance testing. • Obtain regulatory approvals. • Implement design changes.	• Evaluate early production output.
Manufacturing • Identify production constraints. • Set supply chain strategy.	• Estimate manufacturing cost. • Assess production feasibility.	• Identify suppliers for key components. • Perform make-buy analysis. • Define final assembly scheme.	• Define piece-part production processes. • Design tooling. • Define quality assurance processes. • Begin procurement of long-lead tooling.	• Facilitate supplier ramp-up. • Refine fabrication and assembly processes. • Train work force. • Refine quality assurance processes.	• Begin operation of entire production system.
Other Functions • Research: Demonstrate available technologies. • Finance: Provide planning goals. • General Management: Allocate project resources.	• Finance: Facilitate economic analysis. • Legal: Investigate patent issues.	• Finance: Facilitate make-buy analysis. • Service: Identify service issues.		• Sales: Develop sales plan.	

EXHIBIT 2–2

The generic product development process. Six phases are shown, including the tasks and responsibilities of the key functions of the organization for each phase.

Phases of Development