BIOE 435
Topic:
Managing Your Design Project
Areas Covered

- General Project Management
- Design Verification Activities
General Project Management (overview)
Why is Project Management Important?

• Projects have a **Start Point** and the **End Point** (Project Duration)

• Project Management (PM) provides a structured approach to deliver on the project goals and objectives.
The Project Life Cycle

• **Definition** – Goal, Objectives, Specifications, Tasks, Responsibilities

• **Planning** – Schedule, Budget, Resources/Allocation, Risks, Bottlenecks

• **Execution** – Work Breakdown - System Design, Detail Design, Testing, Reports, Change Orders, etc.

• **Delivery** – Final report/documents, deliverables, Implementation, Monitoring
Three Key Management Metrics of PM

• Planning

• Scheduling

• Control
Planning

• Identify a project customer – End user/utility

• Set project objectives

• Establish the end product or service

• Define major tasks required/responsibility

• Estimate total resources and time required

• Establish a budget
Scheduling

• Develop a detailed work plan with tasks
• Estimate time required for each task
• Sequence tasks in proper order
• Develop a start/stop time for each task
• Develop detailed budget for each task
• Assign people to tasks
Control – What are the bottlenecks?

• Monitor actual time, cost, and performance

• Compare planned to actual figures

• Determine whether corrective action is needed

• Evaluate alternative corrective actions

• Take appropriate corrective action
Why? Objectives and Tradeoffs

- Stay within the budget
- Meet the Design specifications
- Meet the deadline
- Due Date!
General Project Management (Useful Tools)
Tools

- PERT Chart
- Gantt Chart
- Risk-Response Matrix
- Responsibility Matrix
- Bill of Materials
- Bottleneck Identification and Mitigation
**PERT**

- Layout a sequencing of required tasks
- Includes details (resource requirements, durations, milestones)

- A – Purchase Material, Duration = 2 wks
- B – Build PCB. Duration = 1 wk
- C – Integrate PCB into device, Duration = 1 wk
- D – Cad Modeling, Duration = 2 wks
- E – 3D Print components, Duration = 1 wk
- F - ...., Duration = 2 wks
- G - ..... Duration = 3 wks
Gantt

• Provides a layout of the tasks & deliverables on a timeline

    Create a chart of all deliverables

    Define activities to reach that deliverable

    Define a sequence for activities across deliverables – what is relationship between activities?

    Estimate activity duration – do you have any time constraints?

    Make the schedule – what needs to be done in sequence? In parallel?
Responsibility Matrix

- Clear expectation of who, what, regarding project tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Richard</th>
<th>Dan</th>
<th>Dave</th>
<th>Linda</th>
<th>Elizabeth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify target customers</td>
<td>R</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>Develop draft questionnaire</td>
<td>R</td>
<td>S</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pilot-test questionnaire</td>
<td></td>
<td>R</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>Finalize questionnaire</td>
<td></td>
<td>R</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Print questionnaire</td>
<td></td>
<td></td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare mailing labels</td>
<td></td>
<td></td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mail questionnaires</td>
<td></td>
<td></td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receive and monitor returned questionnaires</td>
<td></td>
<td></td>
<td>R</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>Input response data</td>
<td></td>
<td></td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analyze results</td>
<td></td>
<td></td>
<td>R</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Prepare draft of report</td>
<td>S</td>
<td>R</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>Prepare final report</td>
<td></td>
<td>R</td>
<td>S</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R = Responsible
S = Supports/assists

# Risk-Response Matrix

- Identifies key risks to the design project and mitigation steps

<table>
<thead>
<tr>
<th>Risk Event</th>
<th>Likelihood</th>
<th>Impact</th>
<th>Detention Difficulty</th>
<th>When</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface problems</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>Conversion</td>
</tr>
<tr>
<td>System freezing</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>Start-up</td>
</tr>
<tr>
<td>User backlash</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>Post-installation</td>
</tr>
<tr>
<td>Hardware malfunctioning</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>Installation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Event</th>
<th>Response</th>
<th>Contingency Plan</th>
<th>Trigger</th>
<th>Who Is Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface problems</td>
<td>Reduce</td>
<td>Work around until help comes</td>
<td>Not solved within 24 hours</td>
<td>Nils</td>
</tr>
<tr>
<td>System freezing</td>
<td>Reduce</td>
<td>Reinstall OS</td>
<td>Still frozen after 1 hour</td>
<td>Emmylou</td>
</tr>
<tr>
<td>User backlash</td>
<td>Reduce</td>
<td>Increase staff support</td>
<td>Call from top management</td>
<td>Eddie</td>
</tr>
<tr>
<td>Equipment malfunctions</td>
<td>Transfer</td>
<td>Order different brand</td>
<td>Replacement doesn't work</td>
<td>Jim</td>
</tr>
</tbody>
</table>

# Bill of Materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Fabricate or Purchase off-the-shelf</th>
<th>No. of Units</th>
<th>Cost/Unit</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>Purchase</td>
<td>3</td>
<td>$5.00</td>
<td>Serve as the wireless controller</td>
</tr>
<tr>
<td>Item 2</td>
<td>Purchase</td>
<td>2</td>
<td>$3.00</td>
<td>Holder for the PCB</td>
</tr>
<tr>
<td>Item 3</td>
<td>Fabricate</td>
<td>5</td>
<td>$6.00</td>
<td>Integrate the O/I ports</td>
</tr>
<tr>
<td>Item ####</td>
<td>Fabricate</td>
<td>...........</td>
<td>...........</td>
<td>...........</td>
</tr>
</tbody>
</table>


Bottlenecks
Bottlenecks Identification Mitigation

• Step 0: What is the goal??
• Step 1: Identify the bottleneck
• Step 2: Exploit the bottleneck
• Step 3: Subordinate every decision to the bottleneck
• Step 4: Elevate the bottleneck
• Step 5: Again!
  • Implement 1 exploit and 1 subordinate and re-run
• Step 6: Change the system
• Step 7: Design the system...choose where to put your bottleneck
EXAMPLE – Heated Travel mug
Structuring The Process: Design and Project Management

• Create a description of the product/system
• What are the key subsystems?
• What are the key components of subsystem
• What are the key tasks to deliver each subsystem
• Assembly completed system (product/service)
• Testing
Simple Description of Product/Service

A wire-less heated travel mug that can keep contents warm for at least one hour. The contents should be able to be reheated inside the container. The mug should be spill-proof and lightweight
Heated Travel Mug - Mockup

- Stainless Steel Inner Cup
- Control and Display
- Rubber Midsection
- ABS Plastic Shell
- Power Puck
- Rubber Non-slip Base
- Lid
Tasks for Power Puck Subsystem

- Design and test rectenna
- Design microwave shield
- Purchase metal ½” screws
- Purchase battery
- Assembly power puck

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Responsible</th>
<th>Support</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and test rectenna</td>
<td>Joe</td>
<td>Steve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design microwave shield</td>
<td>Kathy</td>
<td>Joe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase metal 1/2&quot; screws</td>
<td>Joe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase 9V battery</td>
<td>Steve</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assemble power puck</td>
<td>Steve</td>
<td>All</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Design Verification & Validation
Design Verification & Validation

**Design verification:**
- detailed examination of aspects of a design at various stages in the development

**Design validation**
- cumulative summation of all efforts to assure that the design will conform with user needs and intended use(s)
  - given expected variations in components, materials, manufacturing processes, and the use environment
Verification Processes

• Select a few criteria for evaluating feasibility/quality of design
• Try to apply this to your competitors
Design Validation - Planning

- Early in the design process
- Identify performance characteristics that are to be assessed
- Establish validation methods and acceptance criteria
- Validation plan should be reviewed for appropriateness, completeness, and to ensure that *user needs and intended uses are addressed*

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loudness</td>
<td>50 decibels</td>
</tr>
<tr>
<td>Total Mass</td>
<td>50 kilograms</td>
</tr>
<tr>
<td>Average time to Assemble</td>
<td>&lt; 75 seconds</td>
</tr>
</tbody>
</table>
Design Changes/Document Control

• Documents should be identified (i.e., named and numbered) in accordance with some logical scheme which links the documents to the product or component they describe or depict and illuminates the drawing hierarchy.

• A master list or index of documents should be maintained which presents a comprehensive overview of the documentation which collectively defines the product and/or process.

• Approval procedures should be prescribed which govern entry of documents into the document control system.

• A history of document revisions should be maintained.
Goals for Today

• Get into your groups
• Plan out your schedule
  • Key milestones
  • Compare actual current cost, performance, time to planned
  • Identify what your bottleneck is right now (in this phase of the design process)
    • What will you do about it?
  • Identify where you foresee your bottleneck next semester (or design where you want it to be)
    • What will you do about it?