Management & Planning Tools  
(Helps Teamwork- Chapters 7-9)

<table>
<thead>
<tr>
<th>Tasks</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand Problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study Existing Lifts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop Concepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Produce Prototype</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finalize Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gantt Chart

Affinity Diagram

Interrelationship Digraph

Tree Diagram

Prioritization Matrices

Matrix Diagram
# Gantt Chart

Timeline of Required Tasks: Design an Aerial Lift

<table>
<thead>
<tr>
<th>Tasks</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand Problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study Existing Lifts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop Concepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Produce Prototype</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finalize Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Add Detail by Using Sub-Tasks
Tree Diagram
(Not Function Tree)

- **Purpose:**
  - Show paths and tasks to accomplish primary goal and its related sub-goals
- **First:**
  - List main goal
- **Then:**
  - List “Hows” (means to achieve goal)
  - These become goals for next level
- **Continue until you get to assignable tasks**
Tree Diagram

1. Understand Problem
   - Study Existing Lifts
     - Design an Aerial Lift
       - Develop Concepts
         - Produce Prototype
           - Finalize Design
Design an Aerial Lift

Understand Problem
- Create House of Quality
- Develop Function Tree
- Develop Specification List
- Study Codes and Laws

Study Existing Lifts

Develop Concepts

Produce Prototype

Finalize Design
Tree Diagram

Design an Aerial Lift

Understand Problem
- Create House of Quality
- Develop Function Tree
- Develop Specification List
- Study Codes and Laws

Study Existing Lifts
- Catalog Competitor Products
- Conduct Patent Search
- Assess Strengths/Weaknesses
- Test Best Competitor Products

Develop Concepts
- Create Morph Chart
- Develop Many Alternatives
- Evaluate Alternatives
- Select Best Concept

Produce Prototype
- Make Detailed Part Drawings
- Build Lifting Mechanism
- Test Lifting Mechanism
- Create Several User Interfaces
- Performance Test Interfaces

Finalize Design
- Modify Prototype
- Create Construction Drawings
- Specify Production Methods
Affinity Diagram

- Purpose:
  - Generate and organize ideas

- Start with:
  - What is the issue?

- Then:
  - Brainstorm ideas
  - Survey employees and customers for ideas

- Finish:
  - Gather ideas under affinity headings
**Affinity Diagram Example**

- **Reduce Data Entry Complexity (Selling, Leasing, Tracking Products)**

  - **Improve Training**
    - Error Prevention
    - Problem Solving

  - **Improved Hardware**
    - Optical Scanning System
    - On-Line System at Customer Site
    - Voice Activated System
    - Automated Entry

  - **Friendly Software**
    - Inlet
     - Menu Driven
     - Improve Prompts
    - Outlet
     - Display Only Critical Info. On Screen

  - **Improve Paperwork**
    - Standardize completion Format
    - Increase Size to Increase Legibility
    - Train Clerical Sales and Customer Service Personnel
    - Shorten 11-Digit Product Code
    - Color Code Forms by Product Group
    - Forms Contain Only Non-Standard Customer Information
Interrelationship Digraph

- Purpose:
  - To show causality between items
  - To identify drivers and bottlenecks
  - Can be used to fill in roof of house of quality

- First:
  - Write down items to be discussed

- Then:
  - Draw arrows between items
  - From → to indicates causality

- Arrows
  - Most out arrows → driver
  - Most in arrows → bottleneck
Interrelationship Digraph Example

- Repeated service calls on a coordinate measuring machine

![Diagram of a coordinate measuring machine with a measured part and touch-trigger probe.]
Interrelationship Digraph Example

- Repeated service calls on a machine
Prioritization Matrix

- Purpose:
  - To prioritize items:
    - Prioritization against themselves
    - Prioritization against criteria

- This allows you to focus limited resources
## Prioritization Matrix (Aerial Lift)

<table>
<thead>
<tr>
<th>Task</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create Construction Sketches</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buy Building Materials</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order Electronic Supplies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacture Parts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assemble and Test Lift Mechanism</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create User Interface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Performance Testing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Fatigue Lifecycle Testing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Customer Review</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Legend: X = High Priority, + = Medium Priority, - = Low Priority
# Prioritization Matrix (Math Analysis)

<table>
<thead>
<tr>
<th>Task</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>ΣR</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create Construction Sketches</td>
<td>A</td>
<td>X</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>32</td>
<td>0.148</td>
</tr>
<tr>
<td>Buy Building Materials</td>
<td>B</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>20</td>
<td>0.093</td>
</tr>
<tr>
<td>Order Electronic Supplies</td>
<td>C</td>
<td>-</td>
<td>+</td>
<td>X</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>32</td>
<td>0.148</td>
</tr>
<tr>
<td>Manufacture Parts</td>
<td>D</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>28</td>
<td>0.130</td>
</tr>
<tr>
<td>Assemble and Test Lift Mechanism</td>
<td>E</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>20</td>
<td>0.093</td>
</tr>
<tr>
<td>Create User Interface</td>
<td>F</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>+</td>
<td>12</td>
<td>0.056</td>
</tr>
<tr>
<td>Performance Testing</td>
<td>G</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>X</td>
<td>+</td>
<td>28</td>
<td>0.130</td>
</tr>
<tr>
<td>Fatigue Lifecycle Testing</td>
<td>H</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>12</td>
<td>0.056</td>
</tr>
<tr>
<td>Customer Review</td>
<td>I</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>32</td>
<td>0.148</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>216</td>
<td>1.000</td>
</tr>
</tbody>
</table>

\[+ = 5 \quad - = 1\]
Matrix Diagram

- **Purpose:**
  - To show relations between two sets
  - To show strength of relations

- **Basic types**
  - QFD
  - Job responsibilities
Matrix Diagram (Aerial Lift)

Job Responsibilities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Supervisor</th>
<th>Project Engineer</th>
<th>CAD Engineer</th>
<th>Purchasing Agent</th>
<th>Machinist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create Construction Sketches</td>
<td>N</td>
<td>O</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buy Building Materials</td>
<td></td>
<td>O</td>
<td>X</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Order Electronic Supplies</td>
<td></td>
<td>O</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacture Parts</td>
<td></td>
<td>O</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Assemble and Test Lift Mechanism</td>
<td>N</td>
<td>X</td>
<td></td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Create User Interface</td>
<td></td>
<td></td>
<td>X</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Performance Testing</td>
<td>N</td>
<td>X</td>
<td></td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Fatigue Lifecycle Testing</td>
<td>N</td>
<td>X</td>
<td></td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Customer Review</td>
<td>X</td>
<td>O</td>
<td>O</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

X = Primary Responsibility,  O = Secondary Responsibility,  N = Needs to Know
Relationship of MP Tools to QFD

(1) Affinity Diagram
(2) Interrelationship’s Digraph
(3) Tree Diagram
(4) Prioritization Matrices
(5) Matrix Diagram Relationships

Characteristics

(How) Product Characteristics

Requirements

(What) Customer Requirements

Prioritization

How Much

Importance

Target Values

Importance Ratings

Competitive Assessment
Use of M&P Tools for ME2110 Design Project

- Gant Chart to Create Project Timeline
- Affinity Diagram to Organize Ideas for Each Problem
  (Improve Machine Repeatability, …)
- Interrelationship Digraphs to Debug Machine
  (Loss of Power, Premature Triggering, …)
- Tree Diagrams to Assign Tasks
  (Buy wood, Build frame, Program controller, …)
- Prioritization Matrix to Identify Critical Tasks
- Matrix Diagram to Ensure You are Addressing All Needs
- Etc.
Summary

- Management and planning tools allow you to:
  - Plan more formally
  - Organize information
  - Deal with qualitative information
  - Show relations between items and issues
  - Resolve team disputes

Use Them!!!
Summary

- Management and planning tools allow you to:
  - Plan more formally
  - Organize information
  - Deal with qualitative information
  - Show relations between items and issues
  - Resolve team disputes

*Use Them!!!*
Questions?

If you cheated on the Quiz, then choose one of these options:

1) By 9pm tonight, email your STUDIO instructor this email: “I cheated on the quiz. Please forgive me and give me a 0 on the quiz.”

2) Tomorrow, receive this email from me: “Are you sure that you did not cheat on the quiz?” – Course grade lowered one letter.

3) Deny cheating. Take chances with Dean’s office: Fail course, GT expulsion, Win Lottery.