

This is a low-resolution printable version of the teacher-presentation information. The original PowerPoint slides are clearer and animated to assist the teacher in delivering quality content to the students.

All contents of this file are Copyright 2005, all rights reserved.

Licensed users of the EST Foundations curriculum have access to:

- the original animated PowerPoint files
- accompanying handouts
- detailed homework assignments
- lesson plans including online reading and research assignments, and
- suggestions on integrating this project-based curriculum.

Topic 2 (ver 1.0) Basic Project Skills-Design Method Content of this module

- Bell Work 2.1
- Project Planning discussion
- Project Planning group exercise
- Bell Work 2.2
- Discussion of steps in our design process
- Comparison to other design methods (will require handouts)
- Bell Work 2.3
- Group exercise to apply design steps
- Bell Work 2.4
- Group exercise to prepare for group presentation
- Bell Work 2.5
- Students make group presentations with visual aids (4-6 minutes each)

Copyright: Michael Wienen, 2005
do not distribute without permission

2.1 The Project Life-Cycle

Intentionally left blank

Copyright: Michael Wienen, 2005
do not distribute without permission

Bell Work 2.1

- (Always start a new Journal page for each day. It is o.k. for you to write on the back of the pages. Record the question or task and your response in your Journal.)
- Review the handout on Journal Format and prepare for taking notes in today's class. Modify previous Journal entries to conform to the proper format as time allows. (Remember, Journals will eventually be graded.)

Copyright: Michael Wienen, 2005
do not distribute without permission

Today's Agenda

- Discuss the terms:
 - Project
 - Project Plan
 - Project Life-Cycle
 - Phases of a Project
 - Deliverable
- Develop a project plan for a team project



Copyright: Michael Wienen, 2005
do not distribute without permission

Project Life Cycle for New Product Development

- "New Product Development" is an industrial term for the complete process to bring a new product to market. As with any discrete endeavor, it is a project.
- The term "Project" has also come to have special meaning in industry.
- A Project is a temporary endeavor with a specific goal to generate some new product or service. (Sounds just like "New Product Development" doesn't it?)
- In industry, "Project Managers" are valued experts who know how to initiate, plan, execute, control, and close a project effectively. In fact, "Project Management" is a rewarding technical career of which students should be aware.
- Every Project is unique and has a unique set of phases that can be defined. Each phase should be marked by a tangible deliverable.
- A "Project Plan" defines every aspect of the project's entire life-cycle. This plan defines the beginning and end of a project.

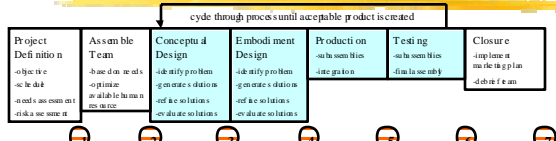
Copyright: Michael Wienen, 2005
do not distribute without permission

Are we doing "New Product Development" or a project?

- I thought we were just building a robot!...
- Well, this is all true...but we might as well learn something as we go.
- "New Product Development" has two parallel aspects:
 - Product Engineering
 - Marketing Analysis
- Designing and Building a working robot are only two *phases* in the "Robot Development Project" that your team is engaging.
- ...and we are really engaging two projects:
 - The Robot Development Project
 - The Robot Marketing Project (whose first active phase is "marketing analysis" which should influence the type of product being developed.)

Copyright: Michael Wienen, 2005
do not distribute without permission

Robot Development Project: Example Phases and Deliverables



Deliverables:

1. detailed life-cycle description including timeline, charts, and checklists, for each phase
2. organizational chart with defined responsibilities for all the team members
3. clearly defined need (including function, structure, and required test performance), documented alternatives, concept that best addresses the need
4. clearly defined need, documented alternatives, detailed documentation of the design that best addresses the need and the production procedures to build it
5. fully functional prototype
6. marketable design with predictable performance
7. product that has been accepted in the marketplace, team that is informed and members are ready for next assignment

Copyright: Michael Wieman, 2005
do not distribute without permission

Exercising your new knowledge

- In groups of 3-5 students, develop a project plan to present a solution that addresses the need "kids need a convenient way to practice their skateboarding tricks."
- You group will have to make a presentation on Friday discussing your project plan (along with a design you contrive on Wednesday) ...so do everything purposefully.
- Today, only focus on your project plan:
 - Define the phases and deliverables of each phase.
 - Estimate the time you will need to spend in each phase. (You will be given time in class on Wednesday and Thursday...the rest is homework.)
 - On Friday, every student must submit his/her own copy of the team's project plan. It will be graded for neatness, how well you explain each phase and organization of information.

Copyright: Michael Wieman, 2005
do not distribute without permission

2.2 Design Methods

Intentionally left blank

Copyright: Michael Wieman, 2005
do not distribute without permission

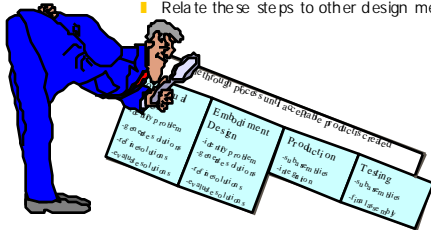
Bell Work 2.2

- (Always start a new Journal page for each day. It is o.k. for you to write on the back of the pages. Record the question or task and your response in your Journal.)
- Silently read the handout discussing various design methods. (handout: [design steps](#))

Copyright: Michael Wieman, 2005
do not distribute without permission

Today's Agenda

- Discuss the steps in the design method that we will use in this class
- Relate these steps to other design methods



Copyright: Michael Wieman, 2005
do not distribute without permission

The Engineering Design Process

- The Engineer's role is generally centered on the phases that are color highlighted in the previous slide.
- Remember: As a trained problem solver, the Engineer only has three basic responsibilities:
 - 1) determine **all** possible solution options
 - 2) choose the **best** option, and
 - 3) implement the solution.
- Because this is theoretically impossible, we need a plan to do the best we can..

Copyright: Michael Wieman, 2005
do not distribute without permission

10 Design steps for Robotics Class

- 1. Identify and Define the Problem
 - 2. Assemble a Design Team
 - 3. Identify Constraints and Criteria for Success
 - 4. Search for Solutions
 - 5. Analyze Each Potential Solution
 - 6. Choose the "Best" Solution
 - 7. Document the Solution
 - 8. Communicate the Solution to Management
 - 9. Construct the Solution
 - 10. Verify and Evaluate the Performance of the Solution
- Important! It is often necessary to cycle through many parts of the process...sometimes many times...to get the Best Solution.

Note: (We will reverse steps 1 and 2 because our class is a predefined team.)

Don't forget that all these steps (except 9 and 10) are applied in the Conceptual design AND the Embodiment design.

Copyright: Michael Wienen, 2005
do not distribute without permission

1. Define the Problem

- Clearly define the problem before considering any solutions.
 - The **source** of the real problem is probably deceptive.
 - If the handle on my screwdriver keeps breaking, do I need to design a better handle or just quit using my screwdriver as a hammer?
 - If the cars keep running into each other, do we need to design wider roads, or safer drivers, or both?
 - To practice skateboarding tricks do kids need a skate park, or just a ramp, or maybe just a video game?

Copyright: Michael Wienen, 2005
do not distribute without permission

2. Assemble a Team

- The optimum team will be different depending on how you define the problem.
 - If you want to design wider roads, then you'll need to get civil engineers and transportation experts involved.
 - If you want to make safer drivers, then you need to get training professionals involved (and maybe even optometrists).

Copyright: Michael Wienen, 2005
do not distribute without permission

3. Identify Constraints and Criteria

- Some limitations are undeniable...we call these "Constraints."
 - Resources are always limited (including time, materials, budget and personnel).
 - Some restrictions are externally imposed like it must be legal and we must finish before competition day.
- Other "design requirements" are made by choice...what we call "Criteria for success."
 - Like aesthetics, quality, safety, or reliability.

Copyright: Michael Wienen, 2005
do not distribute without permission

4. Search for Solutions

- This is the first place to let creativity shine:
 - Can you eliminate the need by redefining the problem?
 - Try to break down all preconceived biases and self-imposed limitations.
 - Use knowledge to find more ideas (analogies in nature, analogies in other disciplines, products already on the market).
- Brainstorming, Synectics, and other methods can be investigated online.

Copyright: Michael Wienen, 2005
do not distribute without permission

5. Analyze Each Possible Solution

- Simple Calculations to see if it is possible
- Compare power requirements to constraints defined earlier
- Run computer simulations
- Perhaps build simple prototypes

Copyright: Michael Wienen, 2005
do not distribute without permission

6. Choose the "Best" Solution

- Might not be the solution that is fastest, or easiest to build, or lasts the longest.
- Must consider all the criteria and find the solution that best meets ALL the constraints and criteria that you have defined.
- Criteria should be defined with some rating on their "priority".

Copyright: Michael Wienen, 2005
do not distribute without permission

7. Document the Solution

- All ideas and decisions should have been documented along the way. Now it is time to polish the drawings and collect everything in a design report.
- In the real world, this documentation might fill a library.

Copyright: Michael Wienen, 2005
do not distribute without permission

8. Communicate the Solution to Management

- What good is a solution that Management doesn't know about or can't understand enough to implement the solution?
- Management needs to know everything about how the solution meets the need and how much it will cost to make...
- In this class, the team coach will serve as the manager.

Copyright: Michael Wienen, 2005
do not distribute without permission

9. Construct the Solution

- Though minor prototyping may have been a part of the analysis steps, now it is time to commit real resources to the product.
- A more detailed prototype should be developed. This prototype must represent the most significant characteristics of the final design
- Since it will take a lot of resources, management will have to be on board.

Copyright: Michael Wienen, 2005
do not distribute without permission

10. Verify and Evaluate

- Just because you went through all the right steps doesn't mean the product works.
- Based on the constraints and criteria, a careful testing plan should be developed to simulate all significant environments and scenarios that might be encountered.

Copyright: Michael Wienen, 2005
do not distribute without permission

According to James Earle

- **Problem identification**
- **Preliminary ideas**
- **Refinement**
- **Analysis**
- **Decision**
- **Implementation**

Copyright: Michael Wienen, 2005
do not distribute without permission

According to Shigley and Mischke

- Recognition of a Need
- Definition of the Problem
- Synthesis of Ideas
- Analysis and Optimization of Ideas
- Evaluation of Solutions
- Presentation of Final Solution

Copyright: Michael Wienen, 2005
do not distribute without permission

According to Pahl and Beitz

- Clarification of the Task
- Conceptual Design
- Embodiment Design
- Detail Design

Copyright: Michael Wienen, 2005
do not distribute without permission

Class work (Teacher: Please adapt for your class)

- Divide the class into 3-4 random groups to compare the other design methods to ours:
 - Earle's 6-step method
 - Shigley and Mischke 6-step method
 - Pahl and Beitz 4 phases of design
- Provide each group with colored paper with Earle's, Shigley's and Pahl's steps listed (one color per group so you can tell whose is whose, cut all the steps apart so there is only one step on each piece of paper).
- Print out [posters for our method](#) (one step per page with very large print) and tape pages in order on the wall.
- Have students tape their colored pieces of paper under the appropriate steps. Discuss the differences of opinion as a class.

Copyright: Michael Wienen, 2005
do not distribute without permission

Homework

- Now that you understand the design process. Apply it step-by-step to the need "kids need a convenient way to practice their skateboarding tricks." (This may have been modified a little by your project plan.)
- On paper write the step number and then document what you came up with for each step in the design process. (Only do steps 1-7.)

Copyright: Michael Wienen, 2005
do not distribute without permission

2.3 Practice With Official Design Method

Intentionally left blank

Copyright: Michael Wienen, 2005
do not distribute without permission

Bell Work 2.3

- (Always start a new Journal page for each day. It is o.k. for you to write on the back of the pages. Record the question or task and your response in your Journal.)
- Silently prepare to describe your homework solution to your small group. Be prepared to defend your decision, but also be willing to adopt other ideas...

Copyright: Michael Wienen, 2005
do not distribute without permission

Today's Agenda



- Get into your 3-5 person group
- Each person take 2 minutes to describe their solution to the homework.
- Spend 5 minutes to discuss all the solutions and choose one single solution.
- As a group, create written descriptions and sketches to completely "explain your solution to management."



Copyright: Michael Wienen, 2005
do not distribute without permission

2.4 Organizing a Presentation for Management

Intentionally left blank

Copyright: Michael Wienen, 2005
do not distribute without permission

Bell Work 2.4

- (Always start a new Journal page for each day. It is o.k. for you to write on the back of the pages. Record the question or task and your response in your Journal.)
- Question: Make a list of the topics that you would include in a five minute presentation on your group's project plan and resulting design solution.

Copyright: Michael Wienen, 2005
do not distribute without permission

Today's Agenda

- Get in to your 3-5 person group
- Develop the presentation that your group will make to the class tomorrow
 - Every person must have equal share in the presentation
 - The presentation must be between 4 and 6 minutes (points taken off for shorter or longer presentations)
 - Don't forget to open with an introduction and close with a summary
 - Visual aids must either be large posters or drawn on overheads for the projector.
 - Don't forget you are presenting your project plan AND your chosen design.
 - **You will NOT be given any time to get ready tomorrow. Plan today!**
- Homework: Each person should write out what they plan to say, practice it, and make sure it fits in the amount of time that the group has allotted for their topic.

Copyright: Michael Wienen, 2005
do not distribute without permission

2.5 Practice Presenting to Management

Intentionally left blank

Copyright: Michael Wienen, 2005
do not distribute without permission

Bell Work 2.5

- (Always start a new Journal page for each day. It is o.k. for you to write on the back of the pages. Record the question or task and your response in your Journal.)
- Silently practice your part of your group's presentation.
- Make sure your part of the visual aids are ready and available... groups will have to quickly take the "stage" as soon as the previous group has finished.

Copyright: Michael Wienen, 2005
do not distribute without permission

Today's Agenda

- Groups will make 4-6 minute presentations.
- Quickly and quietly take your positions when it is your turn.
- If you delay, your grade may suffer.



- At five minutes per presentation, we will barely have time to hear from every group.
- Teacher: it is recommended that you video tape the presentations for later evaluation.

Copyright: Michael Wienen, 2005
do not distribute without permission