PLTW | Engineering

Engineering Design and Development
Summer Assignment

A Message to the EDD Class of 2018

Engineering Design and Development (EDD) gives you an opportunity to exercise the skills you have developed not only in your PLTW classes, but in other classes and in your personal experiences in general. You will work in teams to solve a problem of your choosing. EDD is not focused on producing a marketable process or product, though this can and does happen using the design process. EDD is not intended to be an “invention class” or a “patent generating class” but rather a class that centers on using, documenting, and working through the engineering design process to address a problem. The end result should always be driven by the process rather than an individual or team’s skill sets, opinions, or personal preferences. As an example, students with an interest in electronics and aeronautics who apply the design process to address pilot errors may find that their results point to an ergonomic solution centered on organizing and displaying information in the cockpit rather than developing a new piece of instrumentation or a new control device. Others interested in chemistry and medicine may find that redesigning the way people enter and are processed through an emergency room may be a more effective way to address the rate of disease transmission in a hospital than designing a new chemical disinfectant. Because the focus is on the problem and using the design process, the topic choices for you are infinite.

EDD is about the journey of seeking a well-justified original solution to a real-world problem. Some solutions will prove to have merit as a potential solution, but when tested, will prove to have little value in solving the problem. Some solution attempts will prove to cause as many new problems as they solve, and some will prove to have great merit toward solving the problem in the end. No one will know the solution outcome at the beginning of the journey, but all groups will move through the problem solving process and gain skills they will be able to implement in any profession for the rest of their lives.

Because EDD is less structured than most other courses, you must take more responsibility in your learning than you are accustomed to or are comfortable with taking. However, more responsibility should translate to more ownership and more reward.

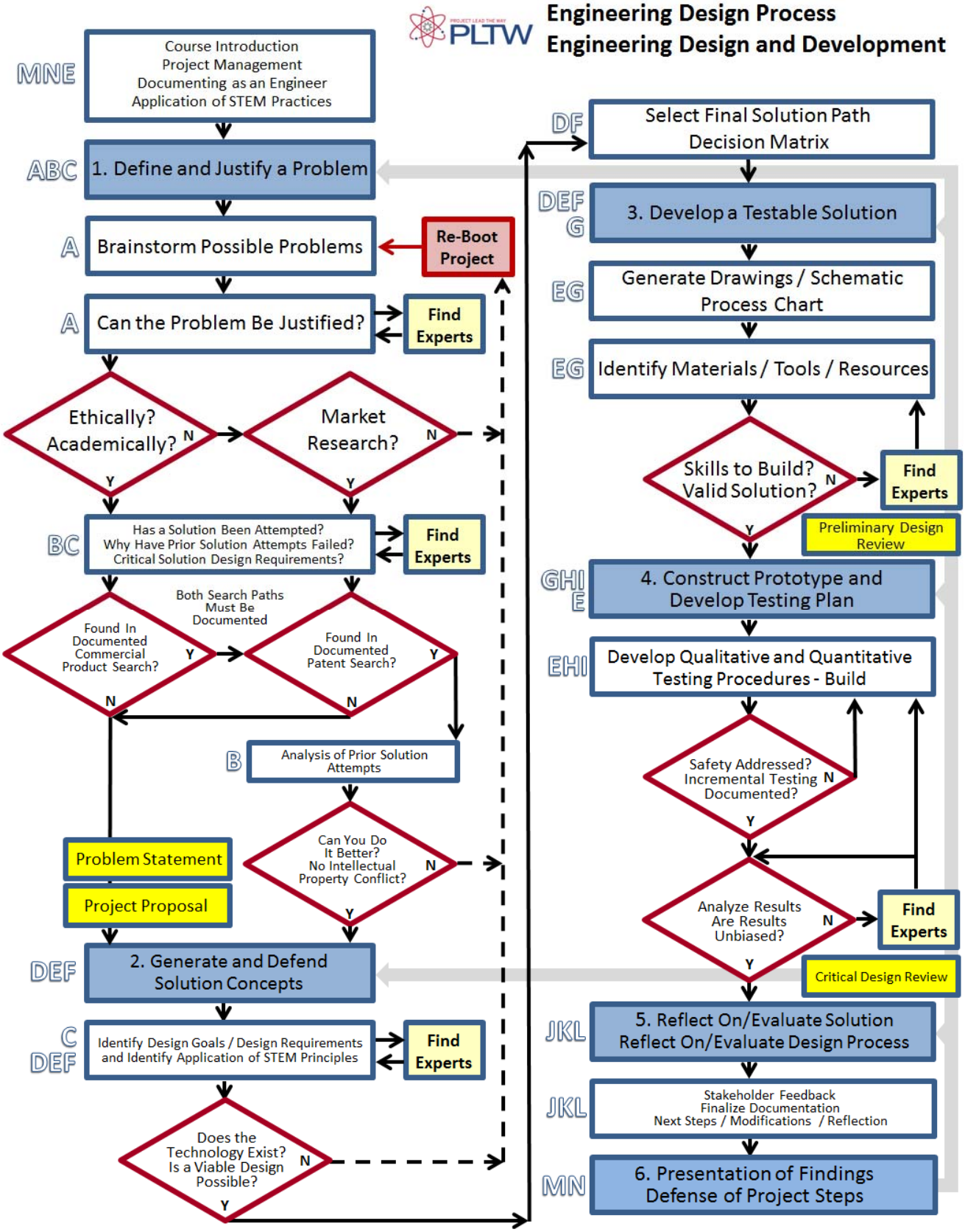
This class will also be much different for you as the instructor, or more accurately, as the facilitator of EDD, Mr. Rice. It will be a memorable year and a rewarding year if you understand the differences from EDD to other more conventional classes as well as the importance of a well-defined problem is a problem half-solved, or as a close colleague of mine always states, “finding the correct problem to solve is 80% of the engineering design process”. With this in mind, please review the EDD Engineering Design Process Flow Chart, the Ten Mighty Questions and the Ten Mighty Questions Flow Chart, the EDD Course Gantt Chart, and the Choosing a Topic documents below. Be prepared to present your problem justification at the start of the school year.

Enjoy your summer and I look forward to next year,

Mr. Rice

EDD Engineering Design Process Flow Chart

Review the chart below and familiarize yourself with each of the six components on the flow chart:



Ten Mighty Questions about EDD

Answering all of these questions thoroughly will lead to a successful EDD experience.

1. **What exactly is the problem that I wish to explore?**
    - A problem well-stated is a problem half-solved.
2. **Who, in fact, says that this really is a "problem" that needs to be solved?**
    - Why should anyone, including me, believe them?
    - A well-written, focused problem statement and the sources which support the statement are the difference between success and failure in research and development. The more credible the sources, the better.
    - Any statement beginning with the words, “I feel” or “I think” has no place in true research and development.
3. **What are all of the current methods or actions that are being used or have been developed in an attempt to solve this problem?**
    - Why, exactly, don't any of them really solve the problem?
    - No matter how good the existing solution(s) looks, sounds, or even holds up to the scrutiny of testing, a *justifiable* problem may remain. Solving the remaining problem may require a shift in the interpretation or even the wording of a problem statement. An example would be the desire to help prevent the Polio disease from spreading throughout the world. A fantastic solution exists in the Polio vaccine, which is purported to be effective in 99% of the human population. So the problem of preventing the disease in 1% of the population still exists and is justifiable, but trying to “reinvent the wheel” by trying to create a better vaccine may not yield the best results with respect to reducing the spread of the disease. A better approach may be to redefine the problem to address the lack of access of the existing vaccine to large populations. Providing these large populations with the vaccine rather than improving the success rate of the existing drug in populations that already have access could result in more lives saved. The problem shifts, in this case, to finding a better way to get the vaccine to underserved populations but still focuses on reducing the number of people who contract the disease.
4. **What exactly is my best idea concerning the solution to this problem and why is it unique in contrast to current or past solutions?**
    - Am I going to
        - Improve the effectiveness of an existing solution (Innovation)?
        - Combine two or more of the existing solutions to achieve a better outcome than any other combination or individual solution (Innovation)?
        - Do I have an idea based upon research that is truly unique (Invention)?
5. **How can I create a tangible prototype/solution for my idea within the confines of my personal skill and the resources that I have available?**
6. **What appropriate methods for testing my prototype can I create, conduct, and document with the resources I have available?**

7. **How can I obtain real, valuable data and present that data to prove any of the following: that my solution worked, that my solution made little or no difference compared to the results of existing solutions, or that my solution was unsuccessful despite a merited attempt?**
    - Even a well-justified testing procedure has a margin of error. The question to ask here is, “How can I be sure that my data is reliable and true?” An embarrassing example of unreliable data occurred in the early 1990s when a group of professional scientists went public with their results of cold fusion, which resulted in humiliation when the results could never be repeated and were found to be instrumentation errors.
8. **If I cannot gather real data by experimental means, how can I justify that my solution has merit?**
    - Can enough evidence be gathered and presented to show that the planned experiment or method has a good chance of producing results that justify funding of the research? And if the research fails to produce the expected results, will knowing WHY the research did not produce the expected results add valuable information to the pool of knowledge surrounding the research? This is the fundamental question for anyone who writes a grant asking for support to perform research or work.
    - What experts can I ask for opinions about my work?
    - No architect has ever been allowed to construct a building just to determine whether it will stand.
9. **How do I best present my entire idea to an audience and justify my actions, thoughts, and results concerning the project?**
    - The only way to fail at scientific research is to fail to explain why the research was conducted and what the results mean.
10. **How can I document my work so that what I have learned can be shared beyond this course?**
    - Write a research paper, create a website, enter the local science/engineering fair, create a formal portfolio for college, etc.

Ten Mighty Questions Project Flow Chart

Justified, Well-Worded Problem Statement

NOTE: A project can be started here as long as justification for the solution's existence can be supported. (Reverse Engineering)

All Current and Past Solutions

Solution #1	Solution #2	Solution #3
How well does it work? Why is it not perfect? (Pros and Cons)	How well does it work? Why is it not perfect? (Pros and Cons)	How well does it work? Why is it not perfect? (Pros and Cons)

Option 1 – Improve an existing solution
Option 2 – Combine one or more solutions to increase the overall success rate
Option 3 – Invent a new or unique solution

Justify the merit for attempting your solution and create a prototype of your idea

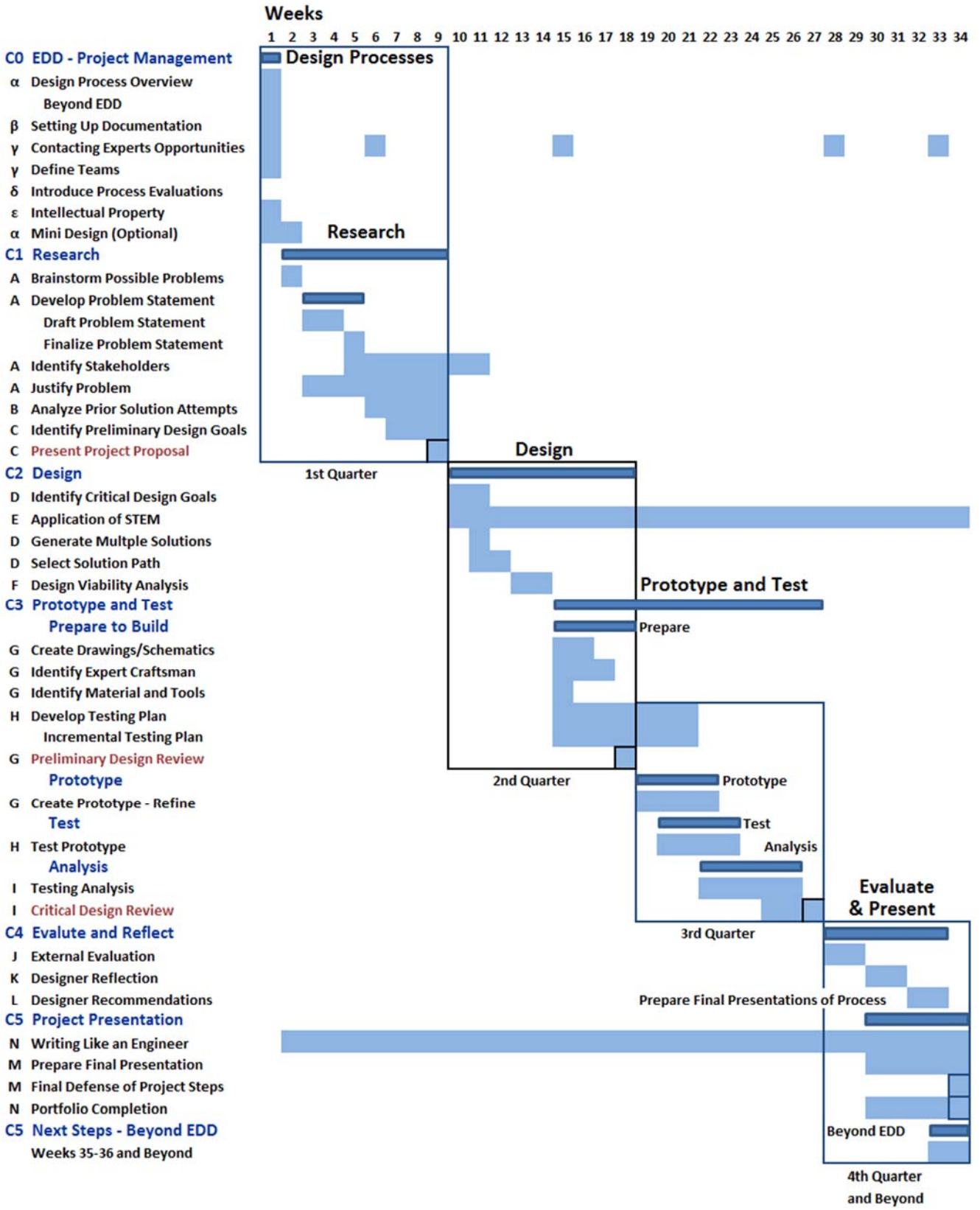
Define and justify an accurate means of testing the

Evaluate the Data

Significant Improvement?	Little or No Difference?	Failure?
Explain Why	Explain Why	Explain Why

Present your findings and make a judgment on what to do with the results

EDD Course Gantt Chart



Choosing a Topic

Wouldn't it be great if every problem you encountered had a fast, simple, and effective solution? In some cases, fast solutions can work beautifully; however, quick fixes are typically only temporary solutions and rarely provide the best solution to a problem. In most cases it is necessary to expend more time and effort in the design process in order to achieve the best results. The Engineering Design and Development process provides the framework for thoroughly examining multiple aspects of a problem and striving for the best possible solution within the given criteria and constraints. But the first step in achieving an effective solution is verifying that the problem is, in fact, valid. That is, you must show that there is consensus among reliable sources that the problem exists.

Some websites post challenges that large companies would like to have solved. Edison Nation at **http://www.edisonnation.com/** provides some good examples.

Equipment

- Choosing a Topic presentation (pdf)
- Brainstorming Help document
- Effective Research document
- Citations APA Style document

Procedure

You will summarize and document your thoughts using notes recorded after previewing the Choosing a Topic presentation (pdf). After you view the presentation, record the information below into a presentation that you will present individually at the start of the school year.

1. Review the Brainstorming Help document. Record five topics that you think are most worth pursuing.
2. For each topic list two or more *significant* problems that you believe could be solved.
    - An example of a significant problem might be "Cars create pollution."
3. For each significant problem, brainstorm three or more specific and manageable problems.
    - Examples of more specific and manageable problems include "Vehicles emit a lot of unnecessary pollution while stuck in traffic," or "Burning fossil fuels to power cars creates pollution."
4. Research each specific and manageable problem using the Internet or other available resources. Document that each problem is valid; that is, that other credible sources believe each to be a problem and that insufficient solutions or no solutions exist. Research multiple sources that can include statistical data (e.g., the National Association of Underwriters says 60,000 home fires each year start while using a deep fryer), bulletin boards (e.g., three out of every ten postings on a motocross website bulletin board talk about the problem of keeping dirt out of the drive chain), and written technical dialog (a medical journal discusses an alternative diagnostic procedure that could be possible if only there were an instrument flexible enough to . . .).

5. Record statements about and/or pertinent to each problem and cite your sources. Be sure to include each source in your list in the APA Citation section of your presentation. Use the Citations APA Style document to help you correctly cite your sources.

Conclusion

1. Why is it important to take large problem ideas and break them down into more specific and manageable problems?

2. During your research, did you discover any existing solutions to the problems that you identified? Were the solutions sufficient or were they lacking?