What Is Engineering Design and Development?

Engineering Design and Development (EDD) is the capstone course in the PLTW high school engineering program. It is an open-ended engineering research course in which students work in teams to design and develop an original solution to a well-defined and -justified, open-ended problem by applying an engineering design process.

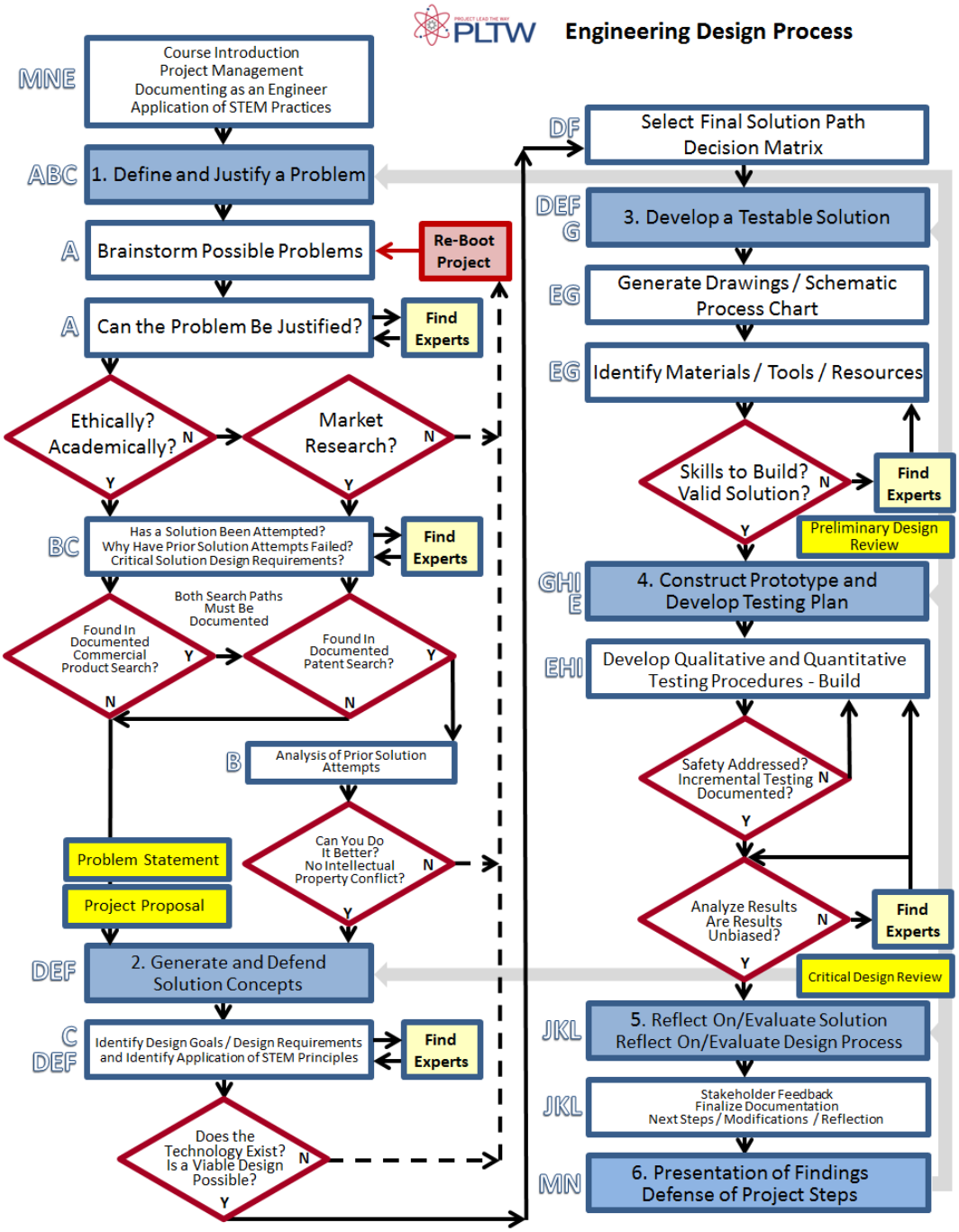
Students perform research to select, define, and justify a problem. After carefully defining the design requirements and creating multiple solution approaches, teams of students select an approach and create and test their solution prototype. Student teams present and defend their original solution to an outside panel. While progressing through the engineering design process, students work closely with experts and continually hone their organizational, communication, and interpersonal skills, their creative and problem-solving abilities, and their understanding of the design process.

Engineering Design and Development is appropriate for 12th-grade students. Because the projects students work on can vary with student interest and the curriculum focuses on problem solving, EDD is appropriate for students who are interested in any technical career path. Because it requires application of the knowledge and skills introduced during the PLTW foundation courses, EDD should be taken as the final capstone PLTW course.

Due to the open-ended nature of the capstone design course, Engineering Design and Development does not follow the activity, project, problem format of the other engineering pathway courses. Because the course is essentially “one large problem to solve” over the entire length of the course, Engineering Design and Development is aligned to the Engineering Design Process Portfolio Scoring Rubric (EDPPSR) assessment tool. The course follows the component and element format of the EDPPSR to help students make the connection to the assessment tool.

An Engineering Design Process

The following flowchart represents the design process students use as they pursue an original solution to a problem.



The Innovation Portal and Engineering Design Process Portfolio Scoring Rubric (EDPPSR)

The EDPPSR tool was developed by university and industry partners and is meant to be a common language for the design process. It is a targeted set of goals and benchmarks that can guide student success through the Engineering Design and Development process.

The intent of the EDPPSR is to eventually offer a validated and reliable framework for a performance-based assessment of the engineering design process for use by educators, teachers, faculty, students, admission officers, and program sponsors. The ultimate goal of the EDPPSR is to provide a means by which to evaluate and score a student's participation in an engineering-based project, regardless of the setting—formal (classroom, curriculum-based) versus informal (extracurricular).

Too often, students participate in programs that include extensive project-based activities (in both formal and informal settings), in which the knowledge and skills learned are not effectively scored or rated for the following purposes:

1. Admissions into other project-based programs
2. Admissions into post-secondary studies
3. Career pathway recognition
4. Advanced Placement or dual-credit into more rigorous academic courses

The Innovation Portal is an electronic-portfolio system aligned to the EDPPSR assessment tool that allows students to collaborate and share their work securely.

Component 0: Project Management

Major focuses of the course are project management and the professional skills required to successfully complete and document an engineering design process. Students study and refine the following topics and skills:

- EDD Design Process and Project Management
- Documenting the Engineering Design Process
- Teams, Timelines, and Contacting Experts
- Project Evaluations and Classroom Management
- Intellectual Property

Component 1: Research

This component requires students to identify a problem for which they design a solution during the remainder of the course. In the first lesson, students write a clear problem statement and validate the problem by documenting credible sources that indicate that the problem exists. Validation is carried out through research and input from experts and mentors.

After their work is defined, students perform additional research to justify the problem by confirming that the expense and effort involved with solving the problem is warranted based on need and cost. Students explore and analyze prior solution attempts. Based on their research, students create a testable design requirement, which is used to explore possible solutions. The students present a project proposal to ensure the project is justified and that all prior solution attempts have been explored.

- Element A – Identification and Justification of the Problem
- Element B – Documentation and Analysis of Prior Solution Attempts
- Element C – Presentation and Justification of Solution Requirements

Component 2: Design

Based on the design requirement identified through research, students develop multiple solution possibilities. Through an evaluation process that involves feedback from experts and stakeholders and the application of a decision matrix or data-driven process, students select the best potential solution to pursue.

Students refine the final selected solution path and provide evidence that the solution they selected is viable.

- Element D – Design Concept Generation, Analysis, and Selection
- Element E – Application of STEM Principles and Practices
- Element F – Consideration of Design Viability

Component 3: Prototype and Test

Based on the defined design requirements, students create a testable prototype and an unbiased testing plan to determine the effectiveness of the solution created.

- Element G – Construction of a Testable Prototype
- Element H – Prototype Testing and Data Collection

Component 4: Evaluation of Project and Process

At this point in the design process, it is critical to seek and document feedback from all stakeholders. The designer(s) should reflect on all design decisions and the analysis that was generated from the testing process. Finally, the designer(s) can begin to formulate next steps.

- Element J – Documentation of External Evaluation
- Element K – Reflection on the Design Project
- Element L – Presentation of Designer's Recommendations

Component 5: Reflection and Presenting the Design Process

At the conclusion of the design process, students present and defend the process and decision.

- Element M – Presentation of the Project and Project Portfolio
- Element N – Writing Like an Engineer

Component 6: Going Beyond EDD

Many opportunities exist for students to receive tangible value for their work beyond the classroom walls. These opportunities range from competitions, scholarships, and university admission notoriety, to interest from business representatives to further develop the ideas created in EDD classrooms.

This section of the curriculum is dedicated to providing resources, examples, and suggestions for helping your students obtain tangible value for their work. Following are examples of student success stories related to College Recognition, Competitions, and Business Opportunities.

- Design and Problem Solving Competitions
- Scholarship and Internship Opportunities
- Product and Business Development Opportunities
- Patents
- Admission Preference or College-level Recognition