2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
ASEE
Paper ID #39287

Flying into Failure! An Introduction to Project Management (Resource Exchange)

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Flying into Failure

AN INTRODUCTION TO PROJECT MANAGEMENT

ASEE 2023
PCEE DIV
RESOURCE
EXCHANGE

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LESSON DESCRIPTION

Only one in twenty mega-projects in engineering will meet both their authorized cost and schedule; the reasoning behind this requires an understanding of the interconnected concepts within project management (e.g., risks, change orders, project complexity).To know what should be considered during the Front-End-Planning (FEP) phases of a project, students need experiences with the various reasons why these mega-projects fail. This low stakes, low resource activity offers those experiences in a way that aligns with the Next Generation Science Standards (NGSS) and an accurate portrayal of the Nature of Engineering (NOE), which ensure students have accurate ideas about what engineering is and how it is done.

GRADE LEVEL*

- Middle School
- High School
- College Freshman

*concepts and challenges modified based on goals and developmental appropriateness

EST. TIME

- ~60 Minutes

MATERIALS

- 8.5x11 sheets of white & colored paper
- Whiteboard & whiteboard markers
- Paper clips
- Masking Tape
- Meter stick
- Timer
- Engineering Notebooks

GOALS FOR STUDENTS

- Collaboration
- Problem Solving Skills
- Communication
- Teamwork
- Critical Thinking
- Robust understanding of Nature of Engineering concepts
- Experience with and development of engineering concepts
- Analyzing Risks and Implementing Risk Management Ideas
- Understanding components and importance of Front-End Planning

NGSS STANDARDS ALIGNMENT

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-3)
- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-PS2-1)

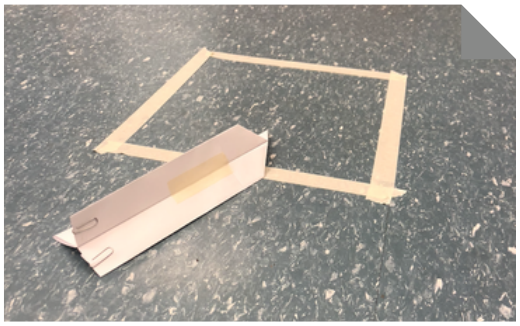
LESSON STRUCTURE

Students are tasked to land a pre-designed paper plane in a 1 square meter landing station. Each member of their team is provided with a different role for the task (e.g., budget manager, quality control, project manager). Throughout the activity, the teacher will introduce various situations which will inevitably up-end the success of the project. The team will need to determine how the changes fits into their budget, schedule constraints, and overall objectives. Similar situations that provide explicit connections to major reasons why mega-projects can fail are provided in the extended lesson and can be utilized according to the teacher's lesson objectives. Through effective questioning throughout the activity, teachers will have ample opportunity to scaffold students from preconceived ideas to a deep development of concepts.

CONCEPTS, MODIFICATIONS, AND QUESTIONS TO ASK

CONCEPT	EXAMPLE ACTIVITY MODIFICATION	QUESTIONS
Cost Impact	Inflation! Material costs have just skyrocketed! Each item has now increased in cost by 20%, yet your budget has remained the same!	• How might this impact your process? • What changes (if any) might your team need to make? What is your rationale for those changes?
Change Orders	In the middle of product development, the project manager receives word that the customer has decided to change the type of paper that the plane is made out of.	• What information do you need to know in order to address the customer's new request? • What changes to your process might your team need to make?
Technology (Tradeoffs and Cost/Benefit Analyses)	A new and improved piece of equipment was just developed and is (fairly) ready for use! If it works well, it will revolutionize the _____ process. This new equipment costs $___ and can be yours to use! Also note, early reports show that this new technology may have negative environmental impacts (high CO_2 emissions).	• What are some benefits/disadvantages of changing your process to use this new technology?

EXAMPLE REFLECTION QUESTIONS



- Choose one of the "Impacts" that occurred. If we were to have to build a plane again in the future, knowing what we know now from this experience, what mitigation plans or changes might you implement to reduce the risk and impact of these occurrences? (HS-ETS1-3)
- Engineering is an inherently creative process. In what ways did you utilize your creativity in the activity? (NOE)
- A pre-designed plane can constrain creativity. What might be other barriers to creativity that engineers face? (NOE)
- As a new challenge arose, what kinds of changes did you have to make to your originally planned process? How did you decide what risks were acceptable? (Tradeoffs; HS-ETS1-3)
- Read through this Case Study of the Boing 737 MAX (Holeman, 2023). What similarities are there to our activity? Where were tradeoffs made and what were the impacts of those decisions? What changes might Boing consider making during Front-End Planning to prevent mistakes like this in the future? (https://tinyurl.com/Boing737MaxCaseStudy)

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