

Aerospace Product Life-Cycle Analysis

Difficulty Advanced	Time 1-2 class periods	Type Aerospace Mission
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Background

A product can meet its immediate performance goal while creating hidden environmental or social impacts during material extraction, manufacturing, use, maintenance, or disposal.

Engineering Problem

Map the life cycle of an aerospace-related product and recommend two realistic improvements.

Learning Objectives

- Use life-cycle thinking
- Identify impacts across product stages
- Distinguish evidence from assumptions
- Recommend feasible design changes

Materials

- Research access
- Life-cycle map template
- Engineering notebook
- At least three credible sources

Procedure

1. Choose an approved product such as a drone battery, aircraft seat component, composite panel, satellite enclosure, or rocket packaging.
2. Define the product function and expected service life.
3. Map raw materials, processing, manufacturing, transportation, use, maintenance, and end-of-life.
4. For each stage, identify energy, material, waste, emissions, safety, or labor considerations.
5. Mark the three stages with the greatest likely impact and support the choice with evidence.
6. Generate four improvement ideas.
7. Evaluate ideas for impact reduction, technical feasibility, cost, and possible unintended consequences.
8. Recommend two improvements and identify how success would be measured.

Engineering Requirements

- Include every major life-cycle stage
- Use at least three credible sources
- Identify at least three impact categories
- Recommend two feasible improvements
- Include one unintended consequence or tradeoff

Constraints & Safety

- Do not claim precise environmental numbers without a valid source

- Keep the scope clear and manageable
- Use respectful language when discussing labor or community impacts

Deliverables

- Life-cycle map
- Source list
- Impact hotspot analysis
- Four improvement ideas
- Two recommendations with metrics
- Tradeoff statement

Reflection Questions

1. Which life-cycle stage was easiest to overlook?
2. Which recommendation had the best impact-to-feasibility balance?
3. What assumption most affected your analysis?
4. How could product life be extended?

Engineering Tip

Define the system boundary. State what is included and excluded from the analysis.

Common Mistake

"Recyclable" does not guarantee recycling will occur. Consider collection, separation, contamination, and market demand.

Stretch Goal

Compare a reusable and single-use version of the same product.

Career Connection

Sustainability, materials, supply-chain, and systems engineers evaluate product impacts beyond initial manufacture.