

Learning from Systems Failure:

*“A Lesson from the US Propulsion
Module Program”*

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Introduction

- Theme:
 - No matter what you do, you will have to go through all the stages of systems engineering when developing a new product.

Background

- The build of the International Space Station (ISS) was several years behind, primarily because the development of the Russian Service Module (used to maintain the orbit) was behind.
- NASA needed to have a back-up plan.
 - **Propulsion Module was the answer.**

Chronology

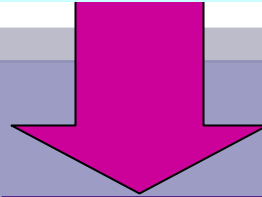
- **Summer of 98:**
 - Boeing convinces NASA HQRTS to procure Prop Module that siphons propellants from the shuttle after it docks with ISS. *The US had never done this before!*
- **Fall of 98:**
 - Project started at MSFC with a Systems Requirements Review scheduled in January 99. A point design is chosen based on a cartoon concept and limited data.
- **February 99:**
 - SRR occurs – technical issues begin to surface.
 - Tunnel diameter
 - Welding versus bolting the sections together
 - *On-orbit Propellant transfer*
- **November 99:**
 - PDR Occurs. Numerous technical problems identified.
- **February 00:**
 - Boeing tells NASA cost will hold even with technical issues.
- **March 00:**
 - Boeing says cost *will grow \$350M* because of technical issues and requirements changes. Requirements changes include testing and verification changes.
- **May 00:**
 - NASA begins new trade study to relook at the best way to do a “PM.”

First Propulsion Module Concept



Systems Engineering Process

Project starts here!!!



**Mission
Definition**

**System
Definition**

**Preliminary
Design**

**Final
Design**

**Fab &
Integrate**

Systems Engineering Process

After trade study!!!

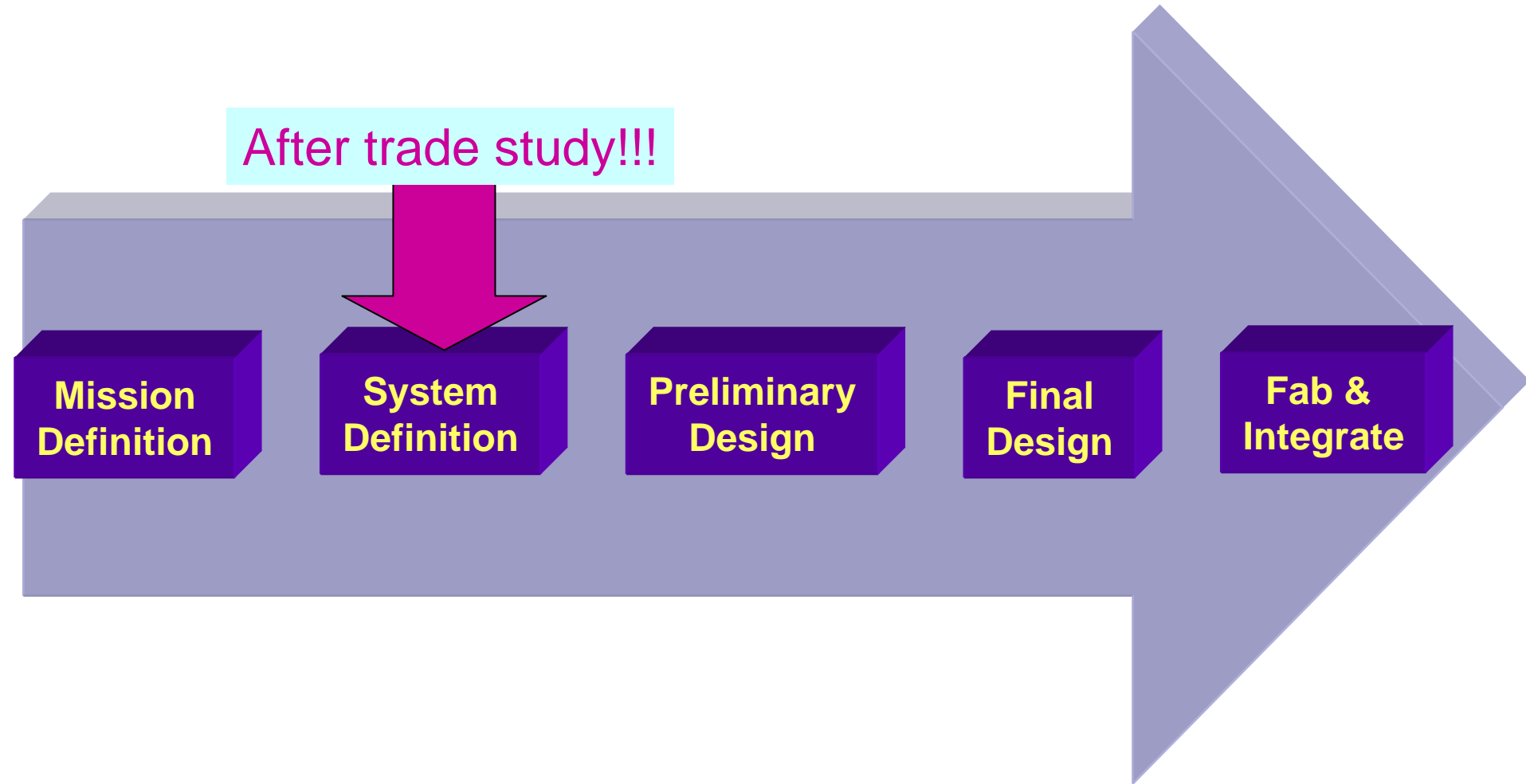
**Mission
Definition**

**System
Definition**

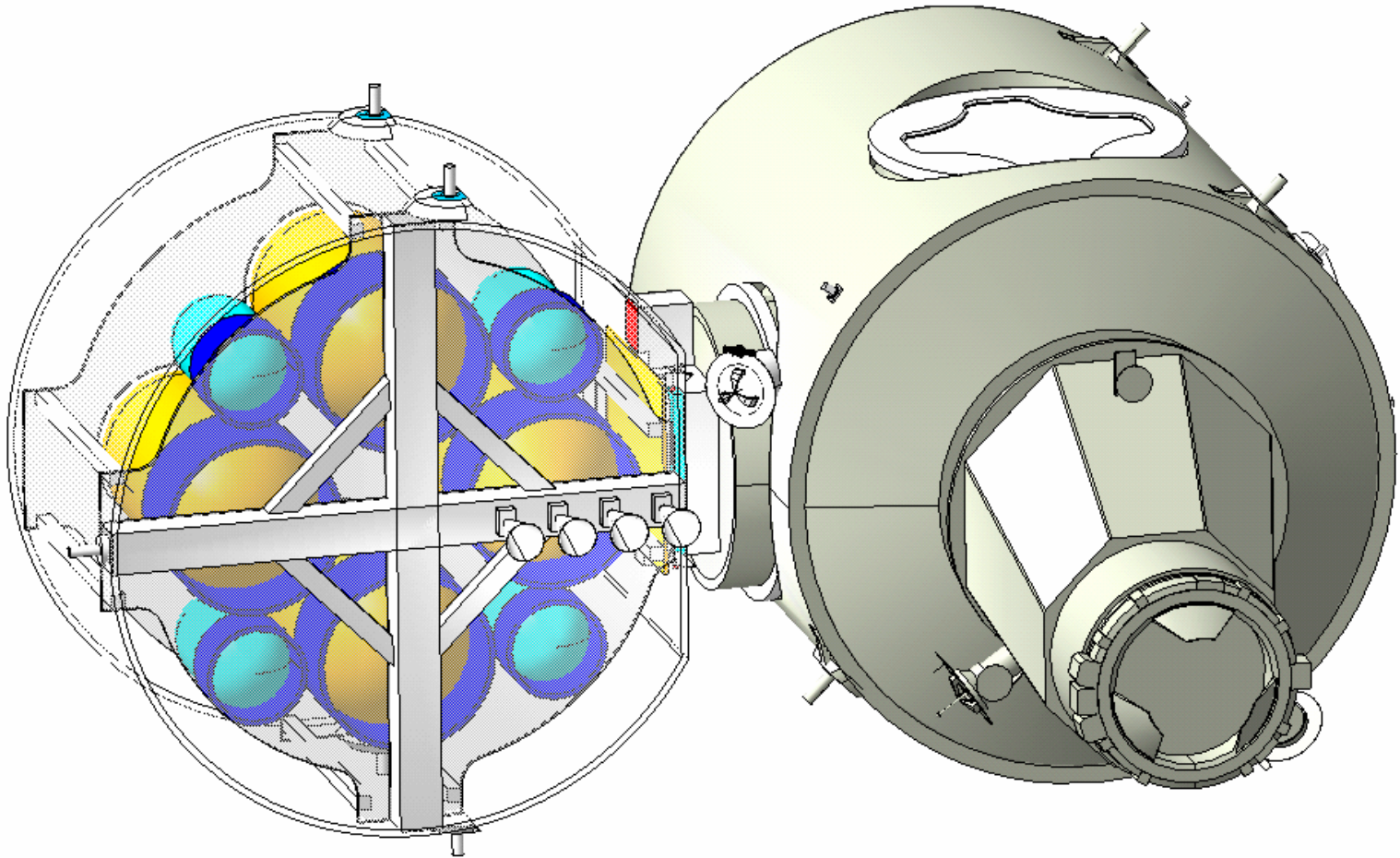
**Preliminary
Design**

**Final
Design**

**Fab &
Integrate**



Later Propulsion Module Concept



Summary

- When NASA chose to skip steps in the systems engineering process it doomed the project to cost, schedule, and technical problems.