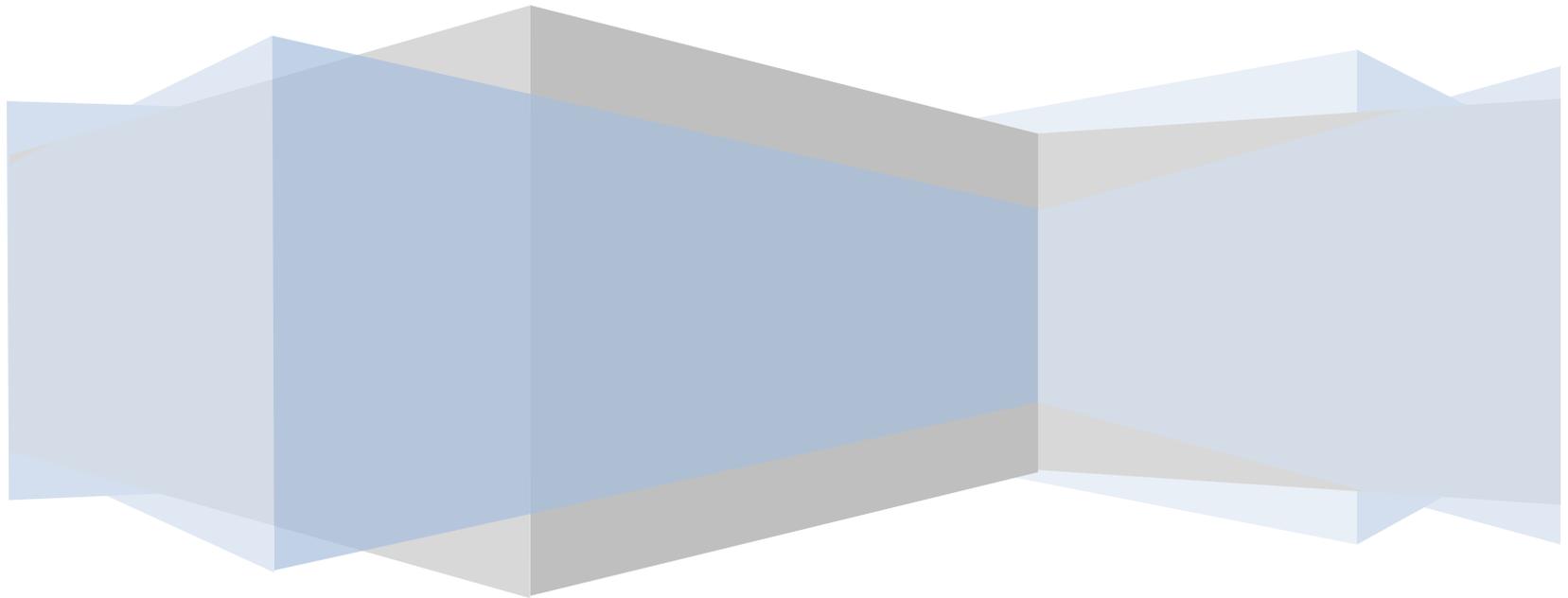


NASA Electronic Non-Conformance System

15.567 Economics of Information

# NASA Electronic Non-Conformance System

Strategic and Economic Analysis



MIT Students

# Objective

- Study development, implementation, and economic impact of an electronic “Non-Conformance” management system created for the NASA Space Program\*

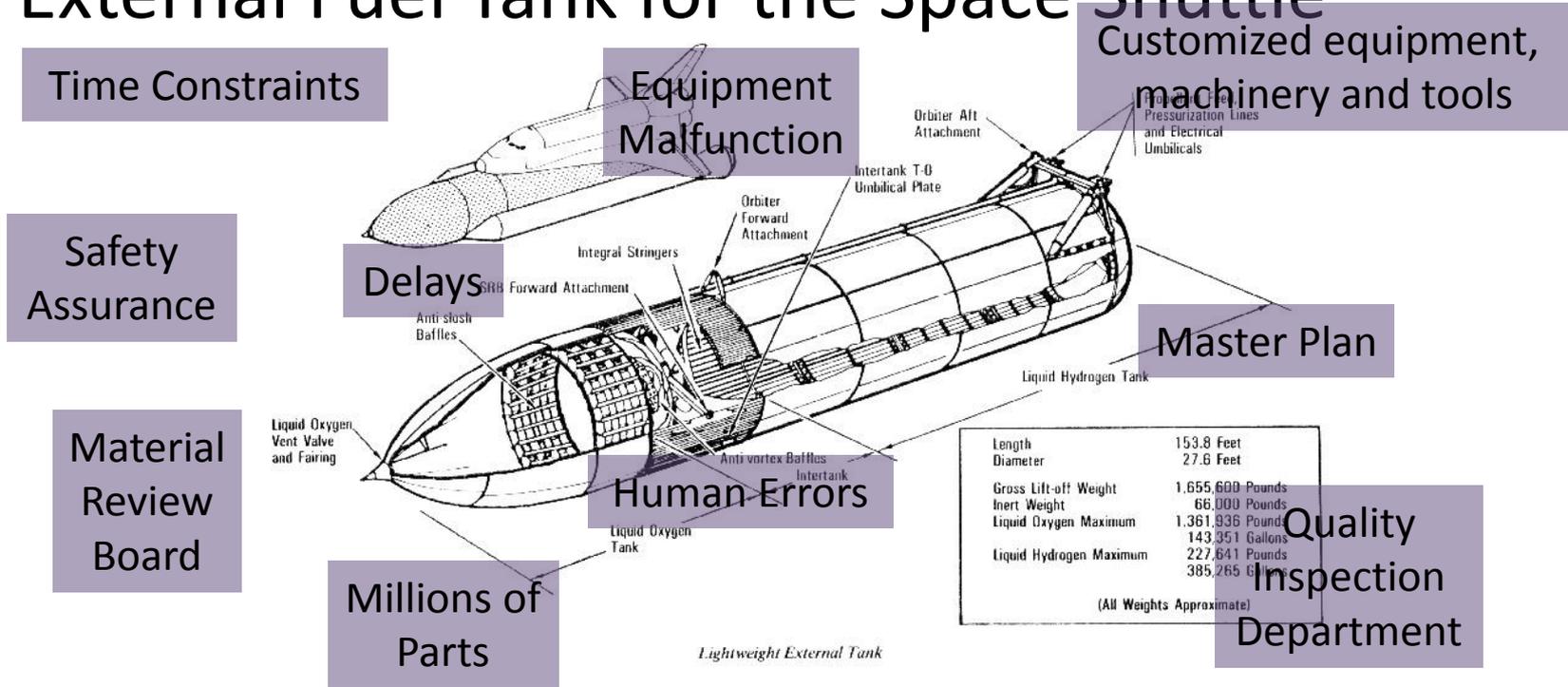
\*specifically the External Fuel Tank for the Space Shuttle

# About NASA - Highlights

- 1958: \$100m budget, 8,000 employees
- Today: \$19bn budget, 23,000 employees
- Along the way:
  - 9 human space flight missions
  - 8 unmanned lunar missions
- Focus of Our Study:
  - NASA facility in Michoud, New Orleans
  - 833 acre facility, one of the largest production buildings in the country

# The Challenge

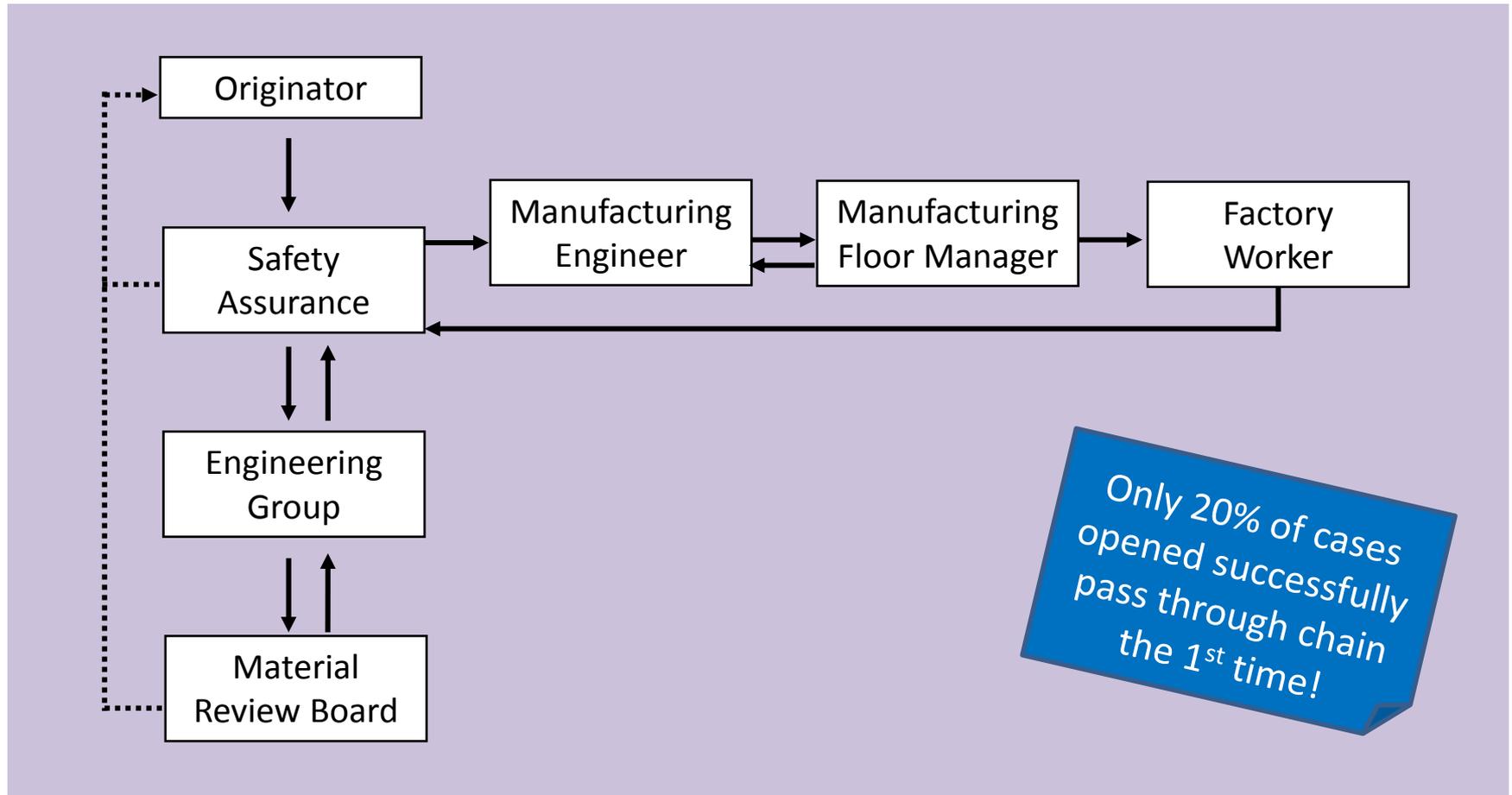
- Example: Manufacturing Process of the \$5m External Fuel Tank for the Space Shuttle



# NCD (Non-Conformance Document)

- Around 20,000 deviations [“Non-Conformances”] / tank
- Thousands of NCD, ranging from 5-2,000 pages, to manage the review process
  - Any given NCD must pass through a variety of departments:
    - Quality
    - Safety and Product Assurance (S&PA)
    - Engineering
    - Floor Supervision
    - Engineering
    - NASA Engineering
    - NASA Safety and Mission Assurance (S&MA)

# Review Process Overview



Only 20% of cases opened successfully pass through chain the 1<sup>st</sup> time!

# Problem with Paper-Based System

- NCDs are hard to replicate and can only be viewed by one person at a time
- NCDs may get lost or damaged
- Tracking the approval process or where the document is physically at becomes difficult
- Also, segregation of job functions is reflective of the misalignment in incentives

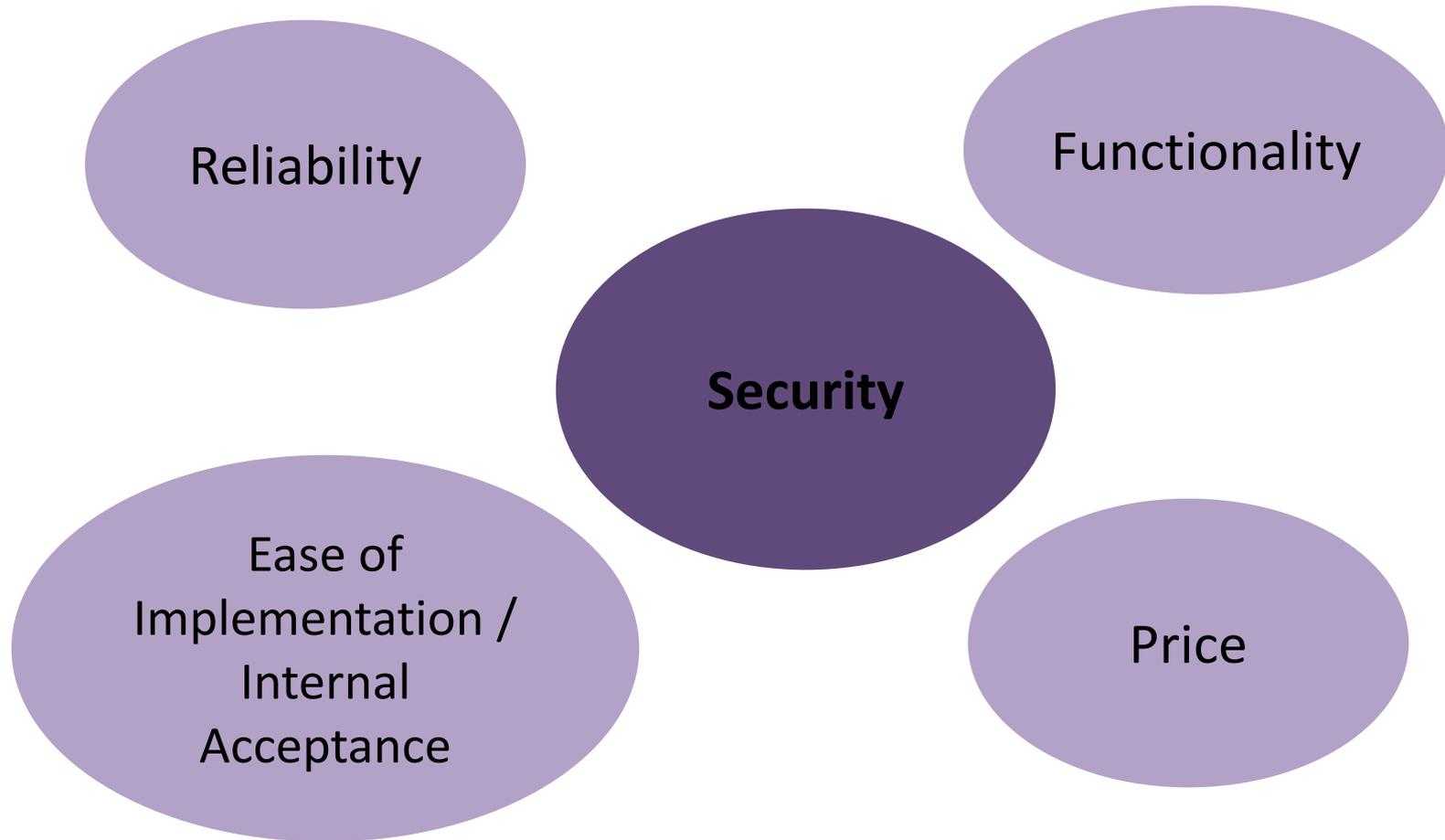


Late 90's, NASA:  
"Need to consider  
Electronic NCDs"

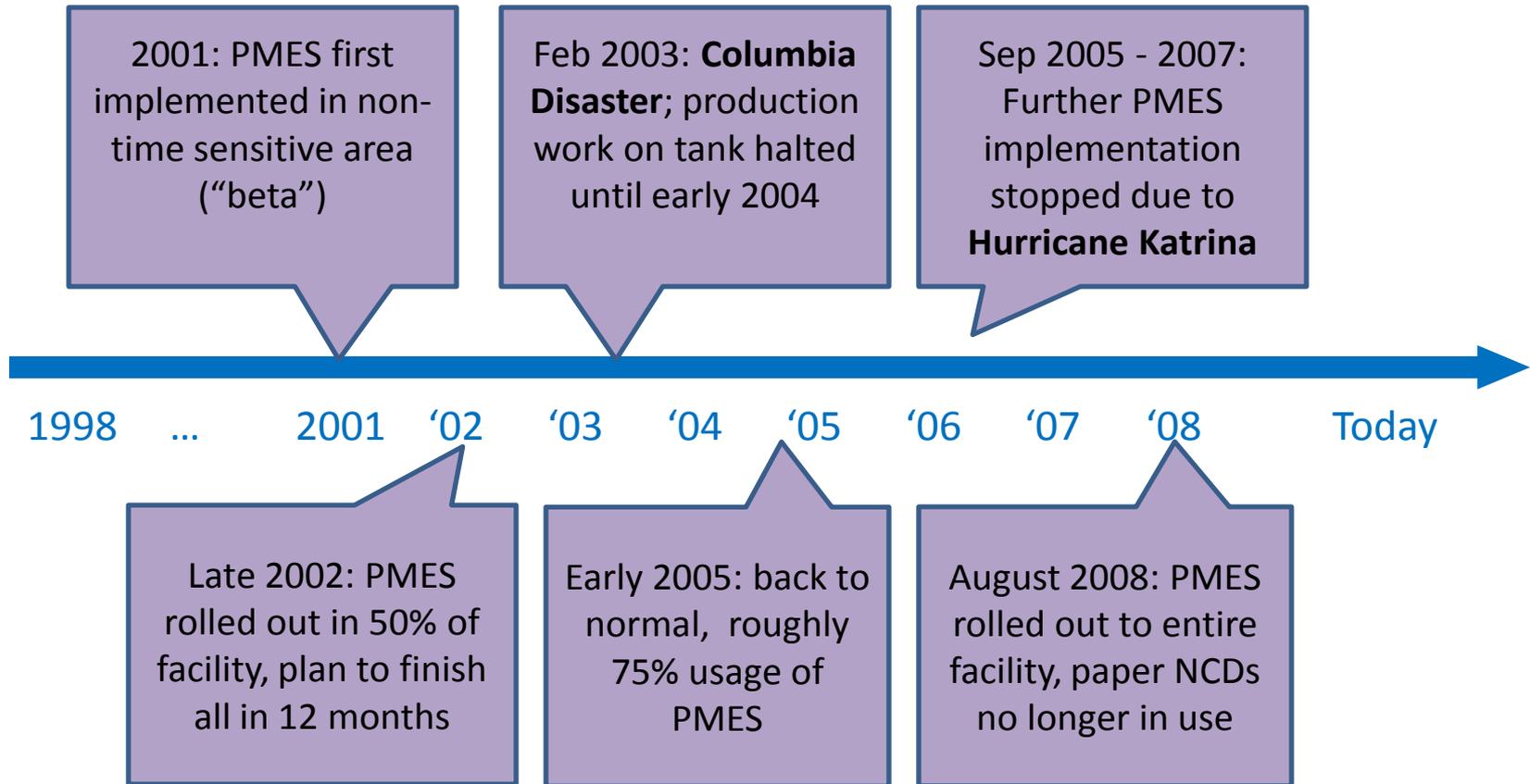
# Technology Options Considered

- Simple Digital Replication
  - Simply duplicate the entire paper based process
  - Not tackle the risk management issues inherent in paper based system
- ▶ Comprehensive Paperless Management Entry System
  - ▶ No enablers such as Java, XML or Wikis available yet
  - ▶ Outsource vs. Internal Development: Given the complexity, refinement over time and idiosyncrasies of a paperless NCD system, decision to build in-house

# Basis for Selection



# Implementation – What Happened?



# Unexpected Issues

- Front line users such as factory workers had **no immediate benefit** of using the system, and often just printed the electronic NCD to work with a paper copy
- Many engineering experts, especially older generations, **refused to use the new system** because they resented the beta product
- Overall the system was **non-intuitive** because it **attempted to directly replicate a paper based system**, which caused user confusion early on
- **Training** sessions were conducted but they were **sporadic**

# PMES Today: A Success?

- Despite existing quirks and inefficiencies in the system, the **implementation of PMES is universally considered a success**, and employees generally prefer it to the paper system
- In 2009, management reported that NCDs were processed faster than ever before
- By all standard metrics the electronic NCD system is now superior to the paper one

# Lessons Learnt

- When moving from paper-based to electronic systems, do not just simply try to replicate the processes
- Conduct user research and get feedback to implement a system which takes into account user needs
- Create incentives for all parties involved to adopt the new system
- Have more effective communication processes
- Provide thorough training sessions

# Questions?

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