

Communicating the Need to Communicate

Lessons Learned From Failure Point to a Need for Systems Perspectives

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Abstract: Failure investigation reports indicate that a systems perspective is needed to reduce failure in aerospace missions. The failures occurred not because of a technical problem but because not enough communication was occurring.

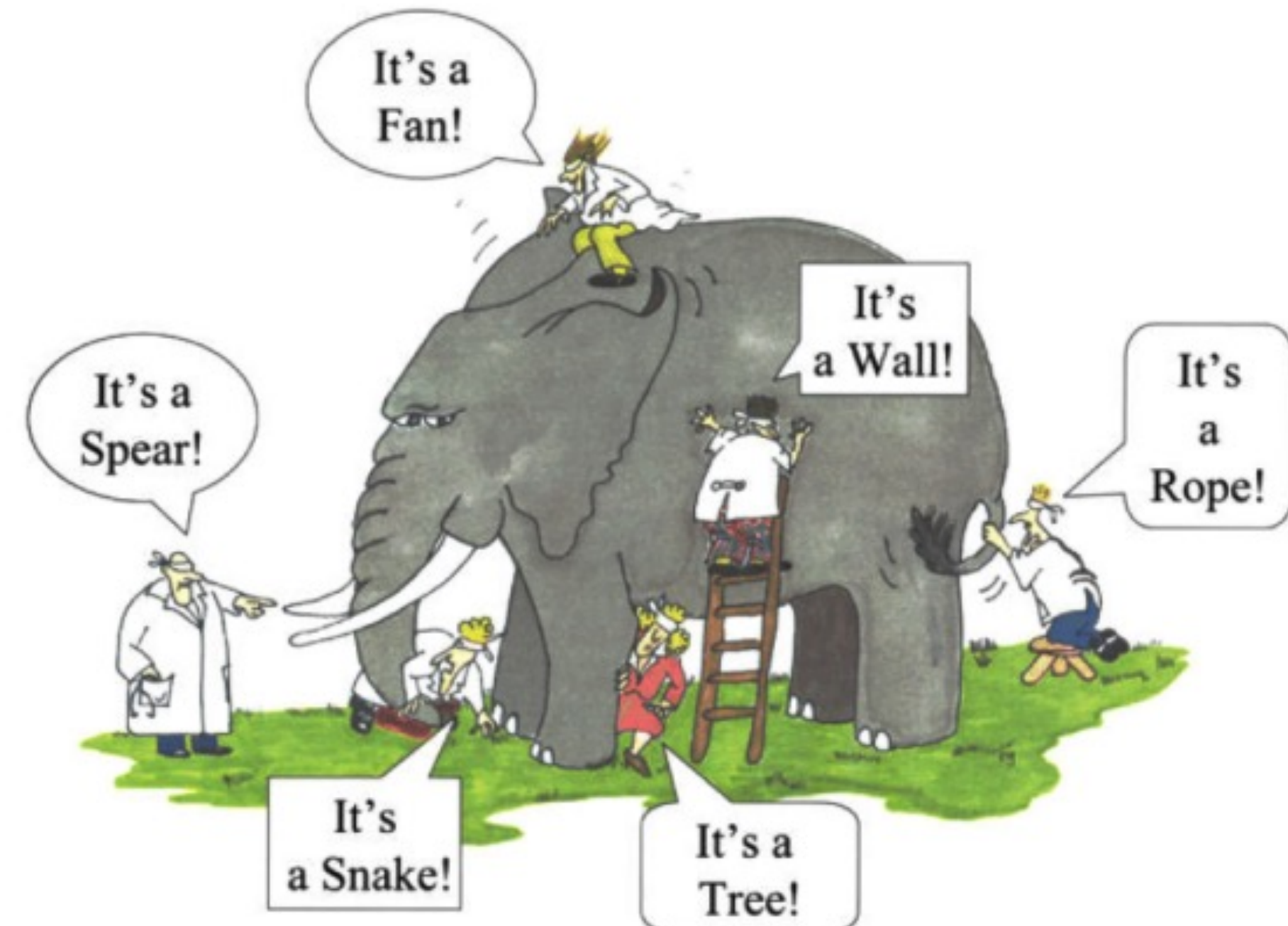


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Systems Perspective

The failure case studies table shows aerospace programs with documented failures and the corresponding recommendations for how to prevent a similar failure in the future. The root case of the failure is definitely a technical issue, but the lessons learned about the organization show that communication enables better decision making and reduces the risk of the technical failure occurring.

A systems perspective comes from focusing on both the details and the big picture to see interconnections. How it all fits together is usually easy to see after the fact, and case studies document programs in a way that the good points and the bad points are apparent.



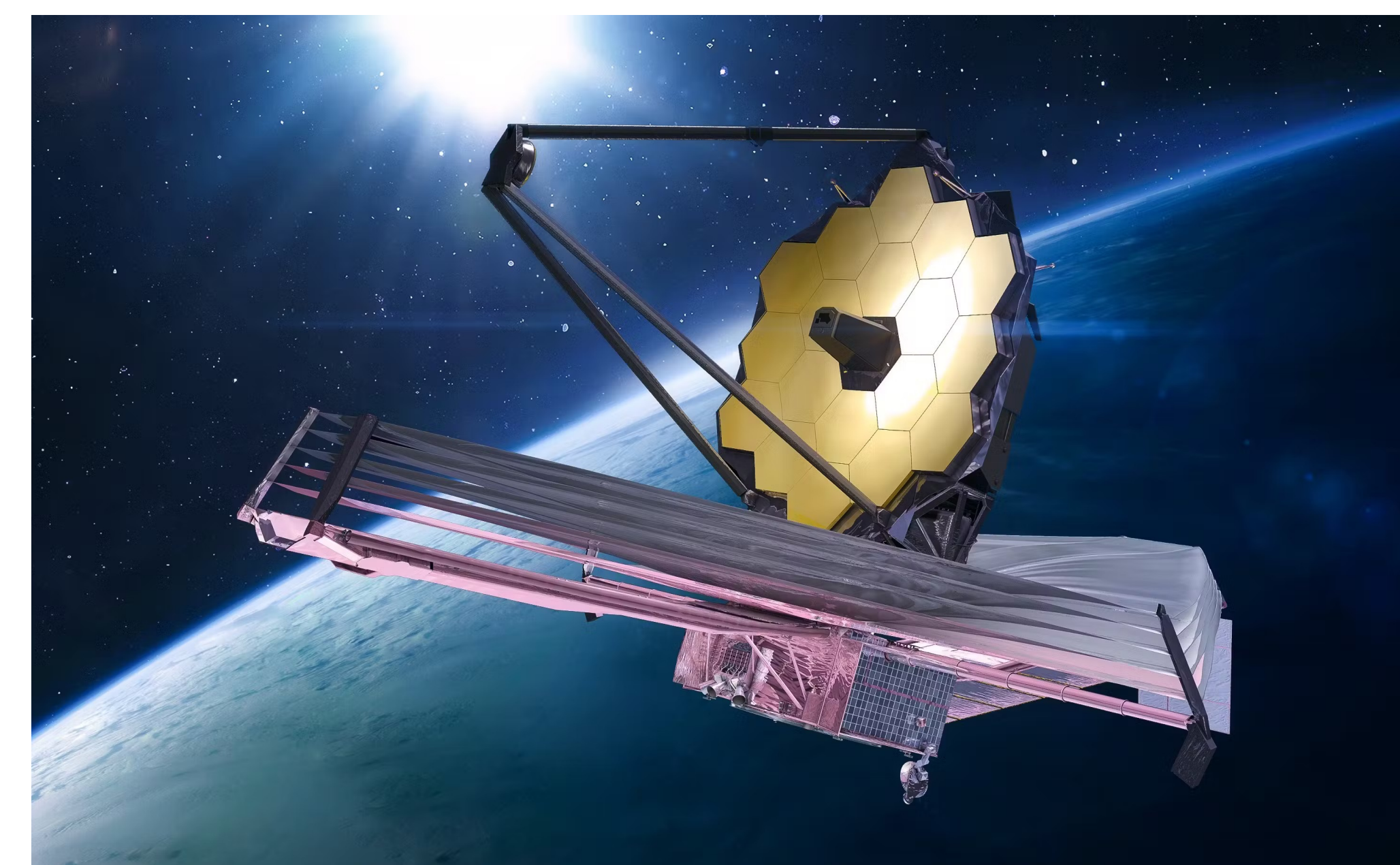
The elephant demonstrates how concentrating on the details doesn't explain how the parts work together synergistically to create a whole.

Aerospace Programs: Failure Case Studies

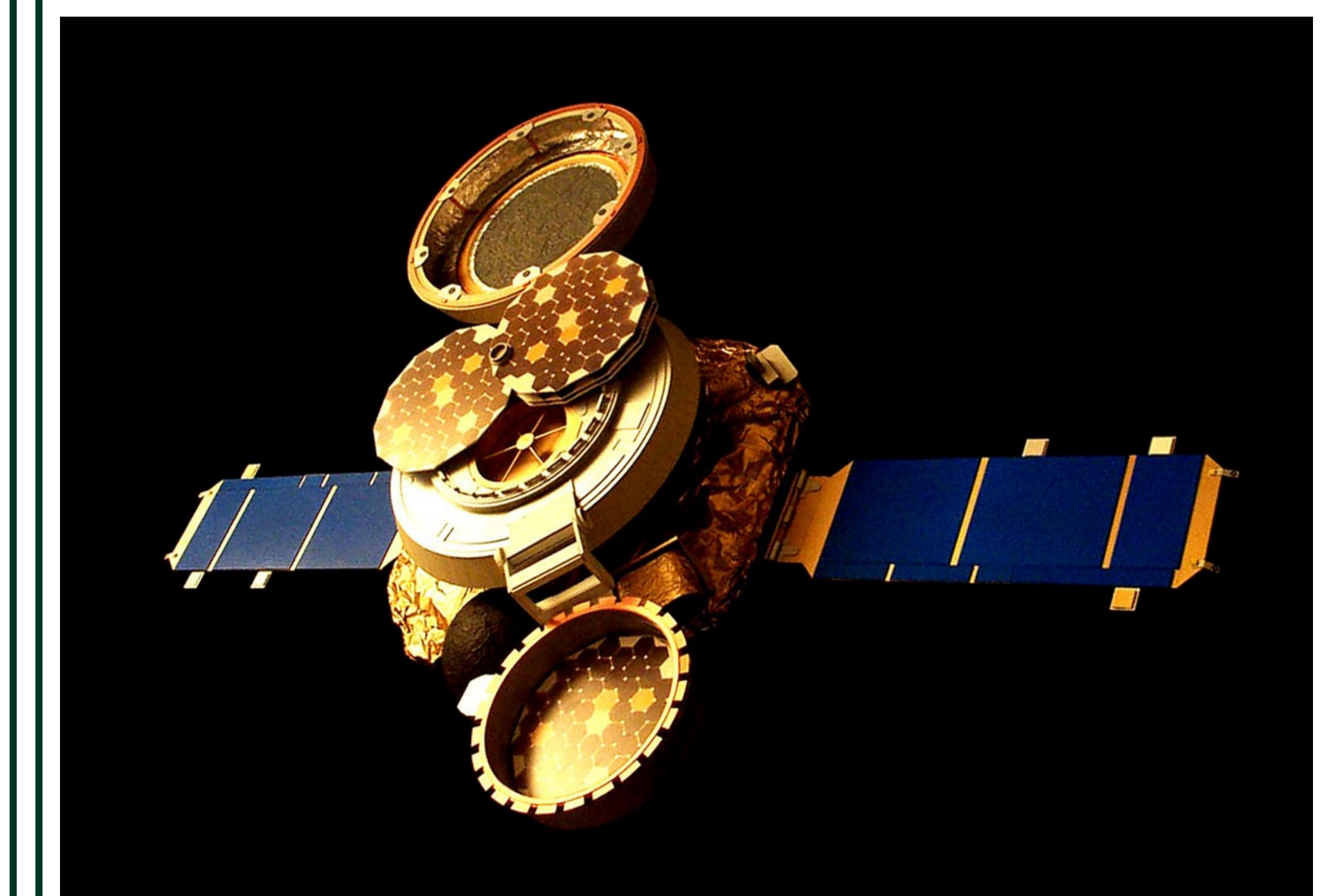
Failure	Launch	Type	Root Cause	Lessons Learned about the Organization
Challenger	1986	shuttle	O-ring failure leading to combustion gas leakage in right solid rocket motor	Organizational silence prevents needed feedback. Accepting past success as good practice is not sustainable.
Hubble	1990	telescope	Major defects in images taken by mirrors	Lack of inter-team communication led to failure even though components are meeting program objectives.
SOHO	1995	satellite	Loss of signal due to operational errors	Uninformed decision making was a result of the narrow focus of each individual team.
Lewis	1997	satellite	Lack of experienced ground operations crew led to loss of spacecraft	Proper resources needed to be given to the most important aspects of the mission to ensure informed decision making.
Mars Climate Orbiter	1998	satellite	Mistake of unit conversion led to atmospheric entry below survivable altitude	Inter-team isolation and lack of communication led to anomalies not being addressed. Concerns were dismissed leading to uninformed decision making.
Genesis	2001	satellite	Design error led to failure of drogue parachute deploying	Lack of systems engineering involvement and inadequate review processes leads to problems not being discovered.
Columbia	2003	shuttle	Foam pieces damaging wing led to burn-up on reentry	Knowing about the issue and still accepting past success as good practice is not always sustainable. Don't fix root causes with short term solutions.
Boeing 737 MAX	2017	aircraft	MCAS software falsely triggered leading to repetitive nose down motion of aircraft	Organizational silence limited the variety of perspectives. Lack of systems perspective throughout program.
James Webb	2021	telescope	Issues resolved slowly due to lack of communication and high-level meetings	Needed more feedback including outside perspectives to give new insight and workers who are not afraid to speak up.

James Webb Telescope

Overspending and schedule delays were due to lack of speed, transparency and direct communication between NASA and its contractor. New leadership pivoted by focusing on independent checks for small problems to prevent them from becoming big problems. Leadership sought individuals who were strong communicators and were unafraid to speak up when they had a different perspective. Emphasis was placed on answering the intent of questions and giving information, not just data. To succeed, a team must be on the same page and communication is how to do it.

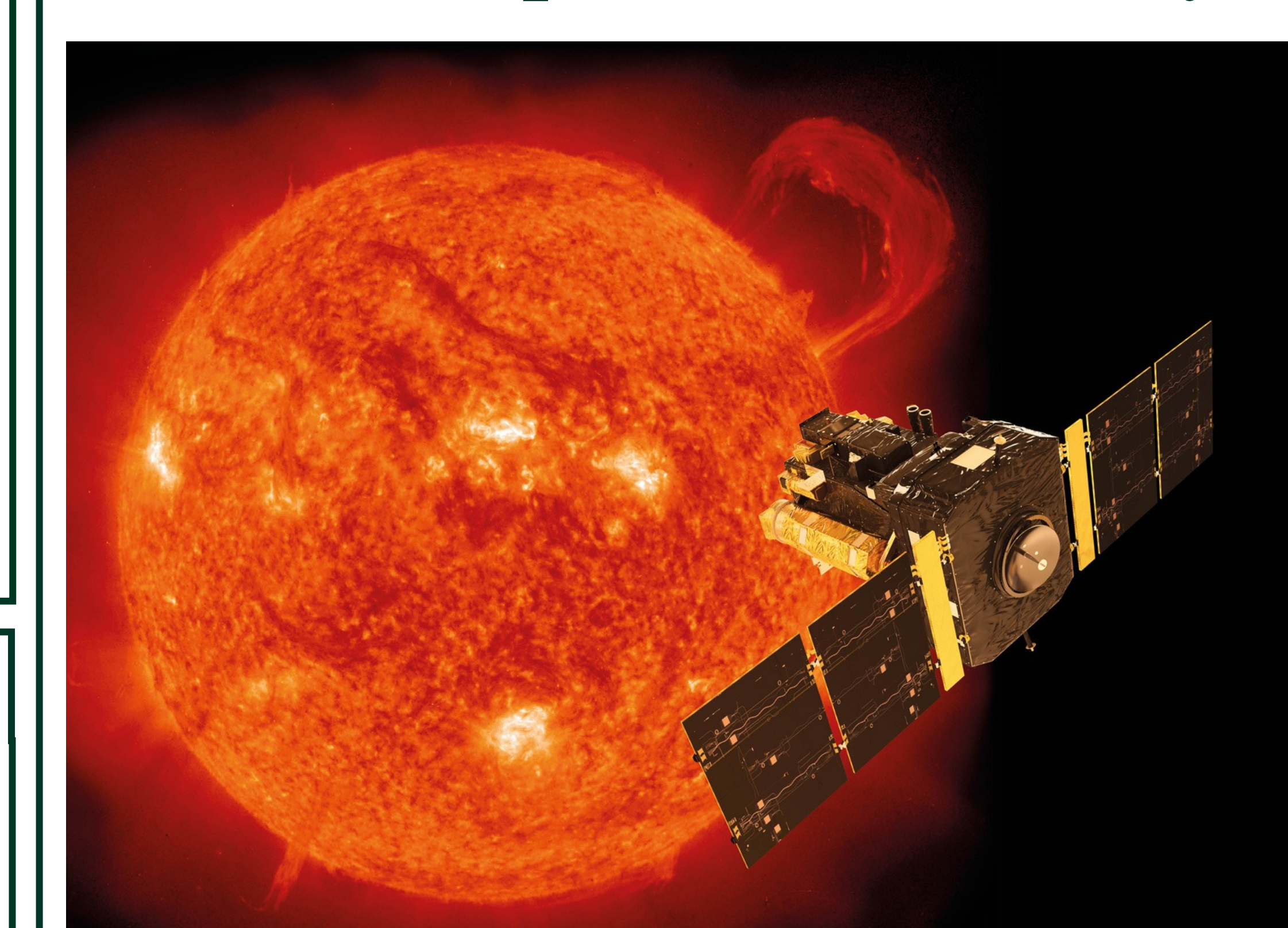


Genesis Spacecraft



Technical design error was not caught during reviews or verification processes resulting in loss of the spacecraft.

Solar Heliospheric Observatory



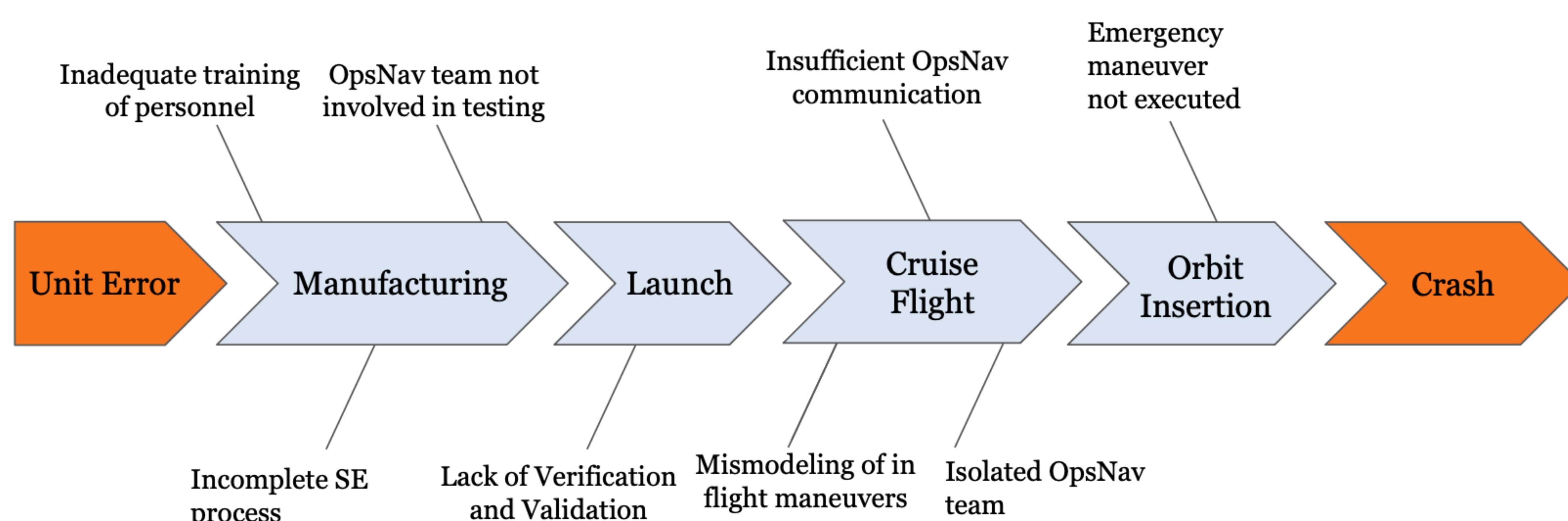
Communication interruption was due to lack of understanding of simultaneous issues leading to decisions being made without all the information that was available.

Mars Climate Orbiter

Failure due to unit inconsistency that was not found during development or operations led to the loss of the spacecraft.



Mars Climate Orbiter (MCO) Error Analysis



The orange represents the root cause, which occurred in the software during the design/manufacturing stage. Represented in the events along the timeline are the contributing factors at different points of the Mars Climate Orbiter's 10-month journey and eventual crash.

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REFERENCES

