

1 Problem

What When	Problem(s)	Loss of Challenger, astronauts killed	
	Date	January 28, 1986	
	Time	11:39:12 AM EST	
Where	Different, unusual, unique	100 year freeze (cold weather)	
	State, city	Cape Canaveral	
	Facility, site	Challenger (STS 51-L)	
	Task being performed	First stage ascent (~46,000' altitude)	
Impact to the Goals	Safety	Loss of 7 astronauts (entire crew)	
	Vehicle	Total loss of Challenger STS	\$1,000,000,000
	Mission	Total loss of mission	
	Equipment	Redesign of solid rocket booster joints	
	Labor, Time	Investigation, testing	
	Frequency	1st loss of shuttle	\$1,000,000,000

CHALLENGER Cause Map

O-ring leaks in cold weather

Just after launch in unusually cold Florida weather, the space shuttle Challenger experienced primary o-ring blow-by, causing an external tank to explode, destroying the shuttle and all aboard.

"Our objective has been not only to prevent any recurrence of the failures related to this accident, but to the extent possible to reduce other risks in future flights . . . It is fully recognized that the risk associated with space flight cannot be totally eliminated."
- Presidential Commission on the Challenger Accident

Cause Mapping is a Root Cause Analysis method that captures basic cause-and-effect relationships supported with evidence.

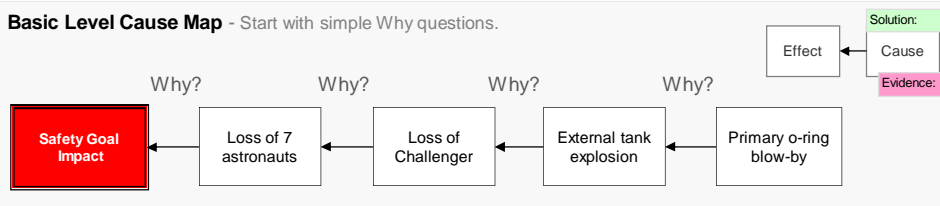
CAUSE MAPPING

Problem Solving • Incident Investigation • Root Cause Analysis

- Step 1 Problem** - What's the Problem?
- Step 2 Analysis** - Why did it happen?
- Step 3 Solutions** - What will be done?

2 Analysis

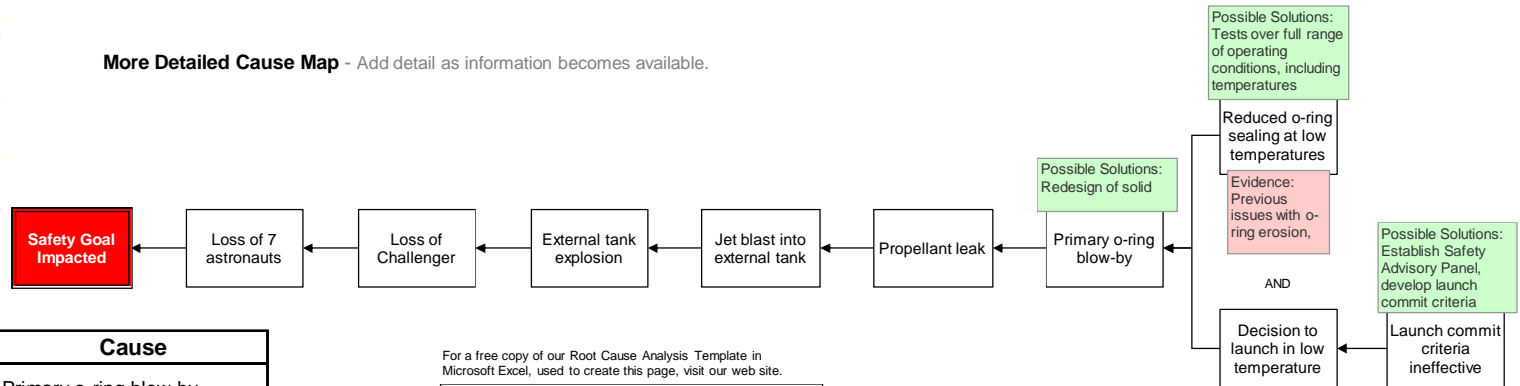
Basic Level Cause Map - Start with simple Why questions.



Challenger Crew:
Standing, L to R: Ellison Onizuka,
Christa McAuliffe, Greg Jarvis,
Judith Resnik
Seated, L to R: Mike Smith, Dick
Scobee, Ron McNair



More Detailed Cause Map - Add detail as information becomes available.



3 Solutions

No.	Action Item	Cause
1	Redesign of solid rocket motor joint	Primary o-ring blow-by
2	Tests over full range of operating conditions, including temperatures	Reduced o-ring sealing at low temperatures
3	Establish Safety Advisory Panel, develop launch commit criteria	Launch commit criteria ineffective

For a free copy of our Root Cause Analysis Template in Microsoft Excel, used to create this page, visit our web site.

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