ORGANIZATIONAL DISASTERS

Inevitability of “Normal Accidents” in organizations where complex system failure runs a risk of catastrophic damage and harm to a large population

- Bridge, dam & building collapses
- Refinery fires
- Bhopal
- Airplane crashes
- Mine explosions
- 3 Mile Island
- Nuclear plant meltdowns
- Chernobyl
- Exxon Valdez

Complex systems are characterized by:

- many connections between subsystems not in production sequence
- unfamiliar or unintended feedback loops
- many control parameters with potential interactions
- indirect or inferential information sources
- limited operator understanding of some processes
TRIGGERING CATASTROPHE

Organizational catastrophes can arise from trivial component failures that cascade across subsystems to damage or collapse the entire system.

In 1978, at Rancho Seco, California, a nuclear plant an operator changing a control panel light bulb dropped it, causing:

- short circuit that knocked out sensors, which
- triggered automatic reactor “scram” (shutdown), but
- dead sensors failed to detect rapid core cooling, so
- falling pressure shrunk metal containment walls, with
- potential cracking of containment and meltdown!
ENGINEERING SAFETY

Safety engineers create technical fixes for vulnerable systems, intended to reduce system error rates to zero.

High-risk organizations should:

(1) build-in redundancies (back-up fail-safe systems) that limit severity of failure consequences

(2) intensively train system operators using routine & disaster simulations (airplane cockpits; hospital operating theaters)
NORMAL ACCIDENTS

Charles Perrow’s *Normal Accidents* (1984) took a sociological view of high-risk orgs as human constructions. By design or unplanned evolution, their vulnerability lies not in individual components or operators, but in unpredictable systemic interactions.

Ironically, adding numerous safety features actually increases system complexity and thus creates new ways to fail,

Rather than less likely, accidents become inevitable ("normal")

With so many interconnected parts, several components may fail simultaneously, cascading upwards to large-scale system-level accident

“For want of a nail … a kingdom was lost”
OPERATOR ERRORS

Impossible to develop “Standard Operating Procedures” covering every unanalyzed contingency

Yet operators must respond to quickly, correctly to incidents: innovate in absence of full information and directions from central authorities

Due to operator incomprehensibility of any complex system interactions, human errors can compound an emerging crisis

• Inaccurate mental images mean an operator’s interventions can make matters worse

• Missing & ambiguous information may seriously delay their quick and correct responses

EX: 3 Mile Island control panel had no instruments for directly measuring coolant levels inside the reactor!
COMPLEX COUPLING

Normal accident situations involve two dimensions that foster unpredictability & inevitable events:

**Interactive Complexity:** two or more failures in supposedly redundant sub-systems can interact in unexpected ways

**Tight Coupling:** sub-components of tightly coupled systems have prompt and major impacts on each other
Diane Vaughan’s cultural analysis of the historical and environmental contingencies that lay behind the risk-assessment and decision to launch Challenger

Morton Thiokol engineers & NASA officials had to determine how likely was a failure of SRB (solid rocket booster) primary and back-up O-rings the morning after an unprecedented cold night on the launch pad, Jan. 28, 1986?

[Unpredictable wind-shear was disaster’s ultimate cause]
CULTURAL CHANGE

Post-disaster investigators’ conventional wisdom: poor engineering analysis, communication failure, GroupThink

Vaughan’s cultural interpretation: Sensemaking in a high-risk organization where problems in innovative technology were expected and institutionalized (taken-for-granted)

Changes in NASA’s culture – its rules, procedures, bureaucratic & technical language – help to explain why the Challenger launch decision occurred despite unprecedented high-risk circumstances

• During Apollo program, NASA had safety-conscious, “dirty hands” technical culture where engineers dominated

• Under Shuttle program, bureaucratic & political accountability pressures transformed NASA’s culture into an institutionalized normalization of deviance in engineers’ risk-assessments:

Gradual toleration of higher levels of “acceptable risk” across successive launches, due to mixed and weak signals about nature of the SBR O-ring problems. New norms required engineers to present solid evidence for delaying launch.
From DEVIANCE to DISASTER

Political & bureaucratic culture dominated engineering safety concerns

- Political: NASA leaders accepted Congress mandate that Shuttle had to pay its way with regular launches; delays were politically damaging to the org
- Bureaupathology: NASA controlled its engineering subcontractors, such as Morton Thiokol, using extensive rules and paperwork requirements

Launch mistake arose in rare convergence of cold temps, teleconference of MT engineers & NASA managers, engineers’ no-go recommendation

“Political accountability took its toll”: Top NASA managers used their organizational power to undermine MT engineers’ interpretations & credibility about the O-ring-temperature data, intimidated them into reversing their no-go recommendation

“Bureaucratic accountability also played a critical role”: Unable to innovate procedures for uncertain situations (‘thinking outside the box’), participants revert to habitual rules and routines
LESSONS LEARNED?

Although NASA reverted to “business as usual,” Vaughan drew several lessons from her cultural analysis, recommending:

• Hold top elites accountable for mistakes, less operator blame
• Top administrators need more hands-on contact with workplace hazards
• Better align org’l goals and resources needed to achieve them
• Improve org’s cultural norms, values, beliefs regarding safety rules & violations
• Strengthen sensemaking to clarify signals, train workers to interpret and respond

QUEX: Are such “social fixes” any more likely to reduce periodic occurrences of org’l normal accidents than are technical safety fixes to prevent catastrophes?
FIRE AT MANN GULCH

Until Storm King Mtn CO fire killed 14 smokejumpers in 1994, the Mann Gulch MT 1949 holocaust was the U.S. Forest Service’s worst org’l disaster

The disaster led to new fire-fighter training in survival tactics, including two-way radios, fitness conditioning, fire science, crew safety taking priority over suppression, & building an escape fire

Read Useem chapter and watch the History Channel video for case details (also Norman Maclean’s Young Men and Fire book)
CRISIS LEADERSHIP

Mann Gulch a failure of effective leadership under crisis

Wagner Dodge’s autocratic, self-reliant leadership style created disastrous “credibility spiral” when confronted by unexpected fire conditions

(a) Lack of communication sharing his experiences, appraisals, plans
(b) Absence of upward info flow from crew to help form better assessments
(c) Failure to build in advance a cohesive team culture to ”instill individual judgment while aligning it around a common purpose”  Shifts “panic point” to far right on stress line
(d) No loyal allies ready to execute leader’s orders w/o question
(e) Cumulative small decision errors in landing zone, march & retreat
(f) “Drop your tools” command → loss of firefighter identity, morale → retreat became “every man for himself”
(g) Thus, Dodge’s brilliant innovation -- the escape-fire method -- was neither understood nor believed by his panicked crew
LEADERSHIP LESSONS

Leadership under crisis conditions involves learned skills that require continual practice to keep sharp:

- Democratic and participative skills that engage a group’s collective efforts
- Communication skills: two-way talking & listening to develop norms of safety and cooperation
- Improvisation: remaining creative under pressure
- “Bricolage”: using whatever materials are hand in novel combinations

QUEX According to Hatch’s cultural theory of organizational change, what process enables a leader’s innovative artifacts to be accepted by followers?
Last week we read about Hatch’s cultural theory of leadership. A charismatic organizational leader introduces new artifacts, such as policies and practices. However, change occurs only if the followers transform such artifacts into symbols that take on new meanings within the existing cultural framework.

After watching the Mann Gulch video & discussing Useem’s chapter, analyze Wagner Dodge’s leadership failure in cultural terms:

• How did Dodge fail to nurture a smokejumper crew culture that was receptive to his life-saving innovative artifact, the escape fire?

• What steps might a more charismatic leader take to increase the odds that followers won’t panic in a crisis situation?