

Manageability of complex construction engineering projects

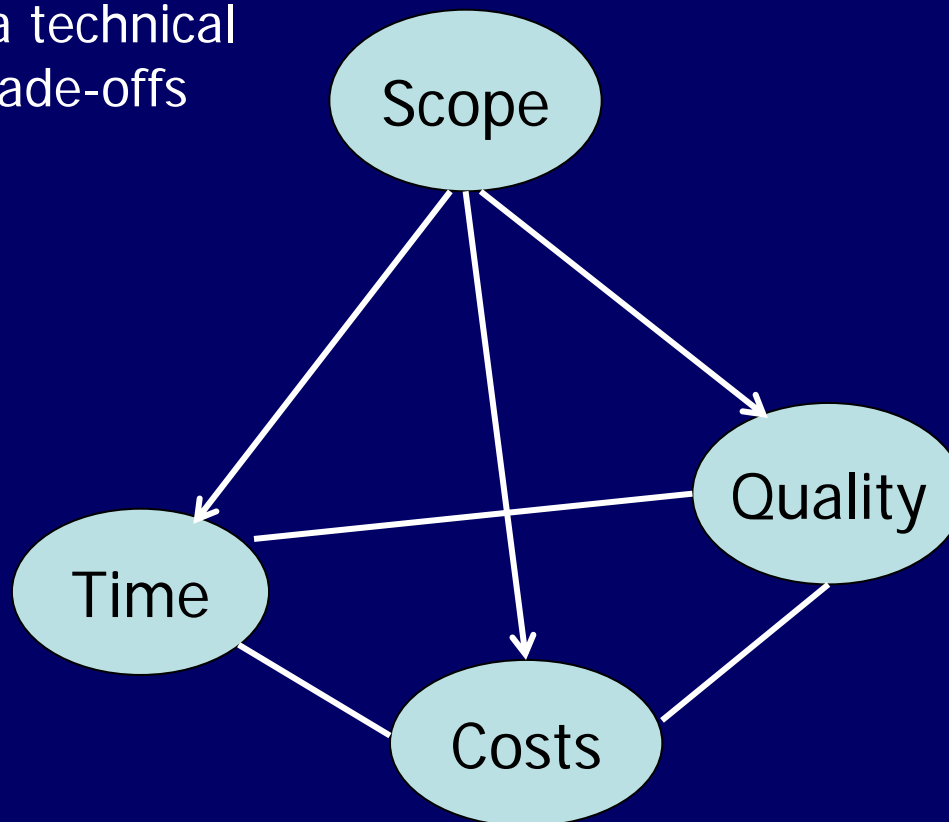
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Outline

- Managing complex projects
- Uncertainty
- Two cases (Big Dig Boston, Souterrain The Hague)
- Uncertainty: information as source of unmanageability
- Possible solutions

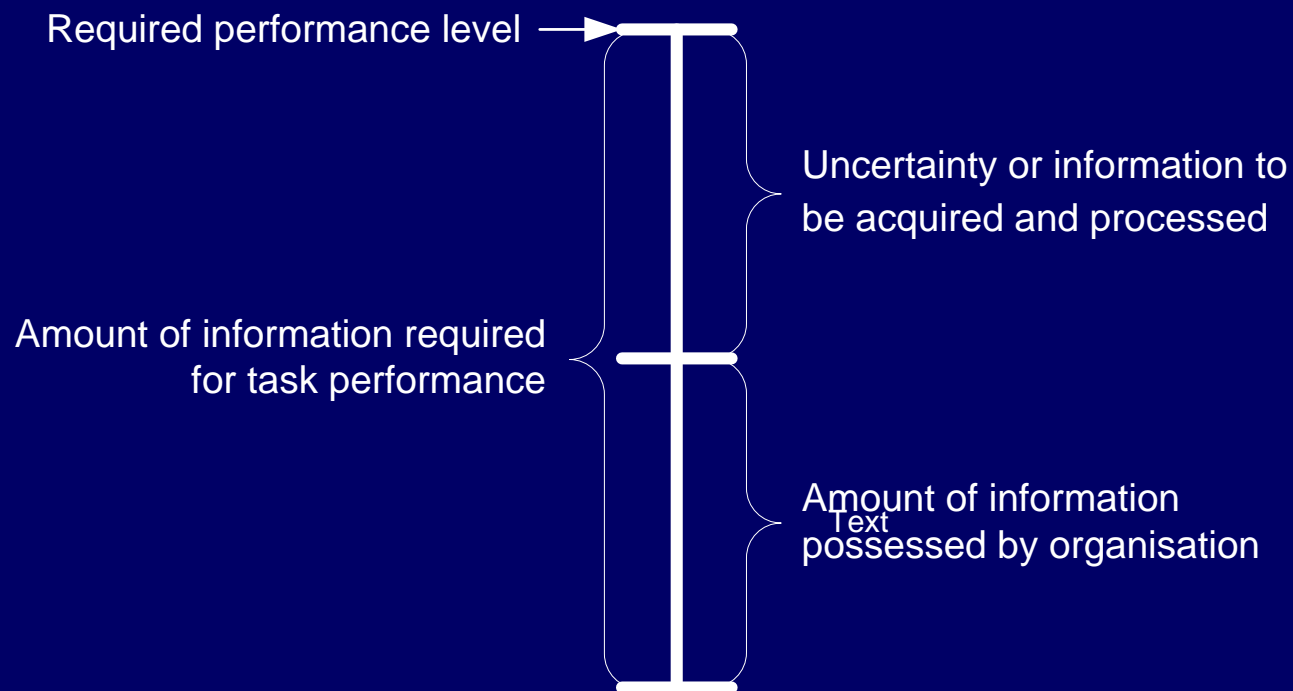
Managing complex projects

Realizing a technical system: trade-offs of values



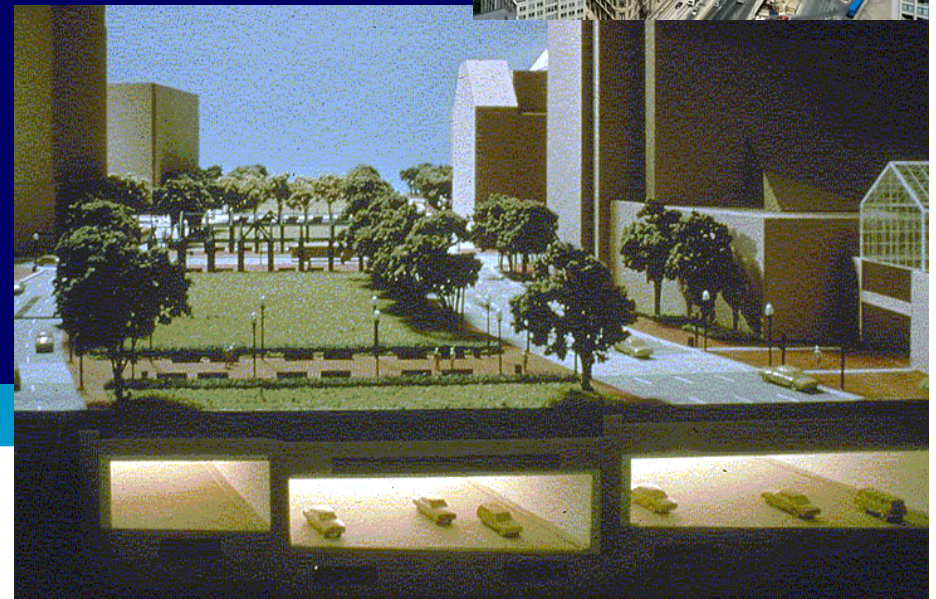
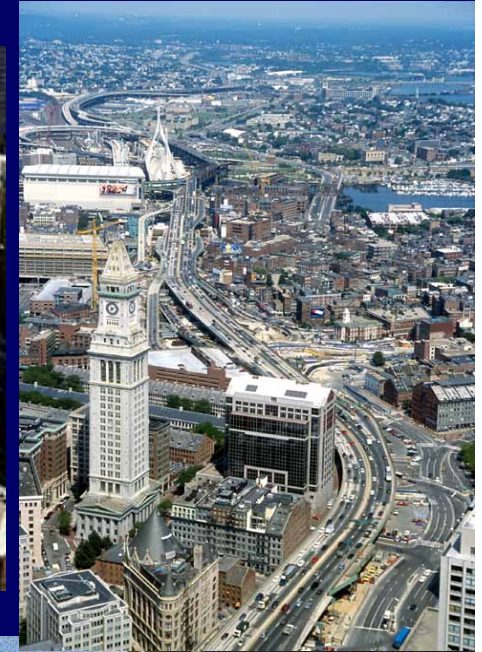
J.R. Turner (1993), The Handbook of Project Management

Uncertainty in the trade-offs



J. Galbraith (1977), Organization Design

Central Artery Tunnel Boston (Big Dig)



Uncertainty and unmanageability

- Construction technically rather successful, but budget overrun on a large scale
- Technical problems do occur after opening
- Numerous leaks in downtown tunnels
- 2006: collapse ceiling in I-90 connector tunnel
- Dynamics of project implementation (design changes, differing site conditions etc.)
- Interfaces spread changes and uncertainties through numerous subsystems

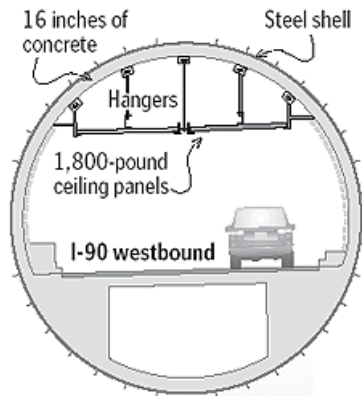


From: Boston Globe

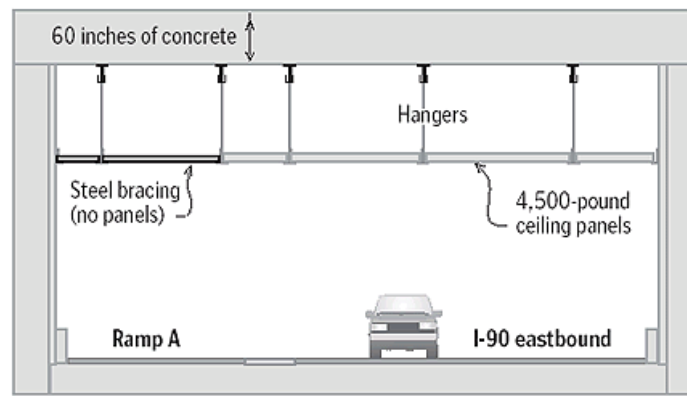
Changes to Connector Tunnel ceiling

Governor Mitt Romney said yesterday that bolts held with epoxy were used in more locations than had previously been reported and that some in the Ted Williams tunnel had become loose.

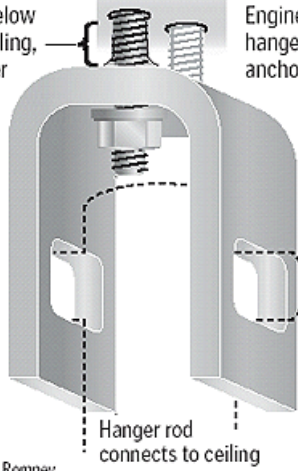
TED WILLIAMS TUNNEL



I-90 CONNECTOR TUNNEL



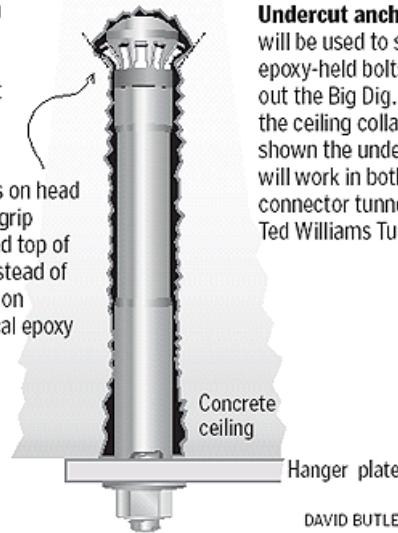
One hanger was found an inch below the ceiling, another half an inch low.



SOURCE: Governor Romney

Two epoxied bolts now attach each hanger to the ceiling. Engineers are designing new hangers held by four undercut anchor bolts.

Flanges on head of bolt grip widened top of hole instead of relying on chemical epoxy bond.

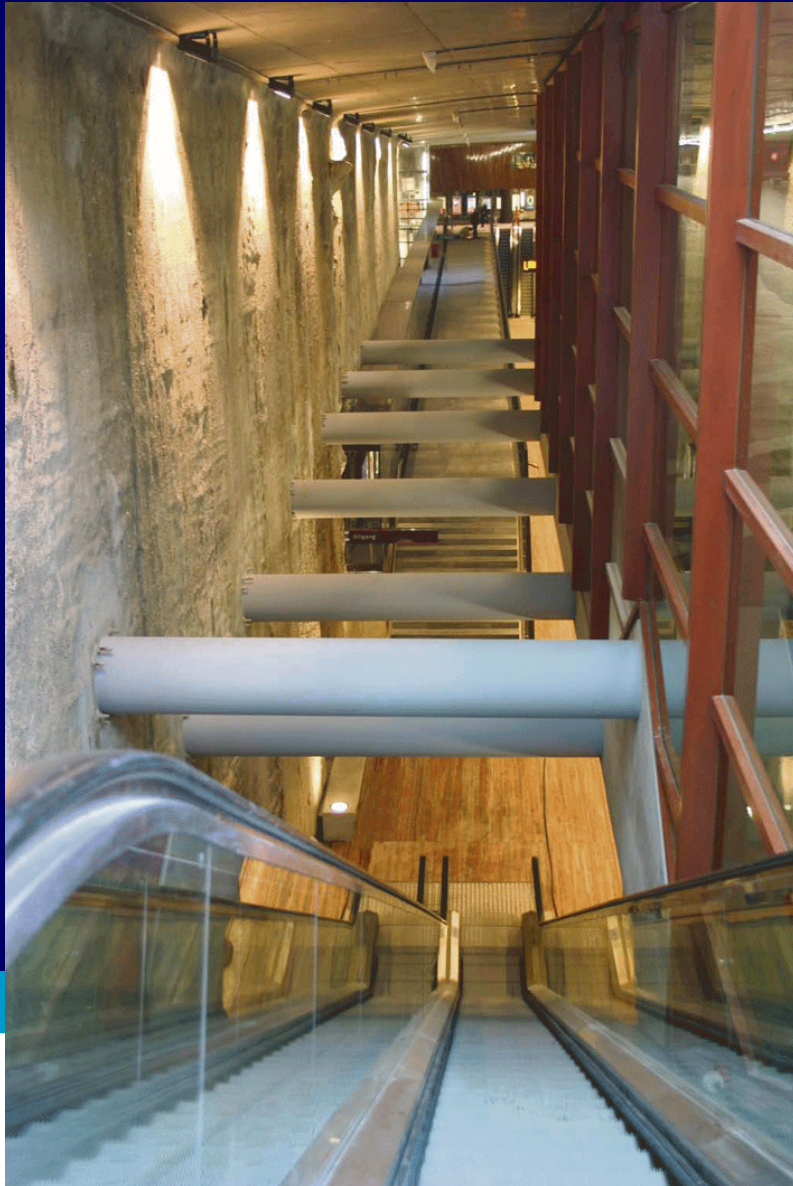


Undercut anchor bolts will be used to supplement epoxy-held bolts throughout the Big Dig. Tests since the ceiling collapse have shown the undercut bolts will work in both the I-90 connector tunnel and the Ted Williams Tunnel.

DAVID BUTLER/GLOBE STAFF

From: Boston Globe

Souterrain The Hague

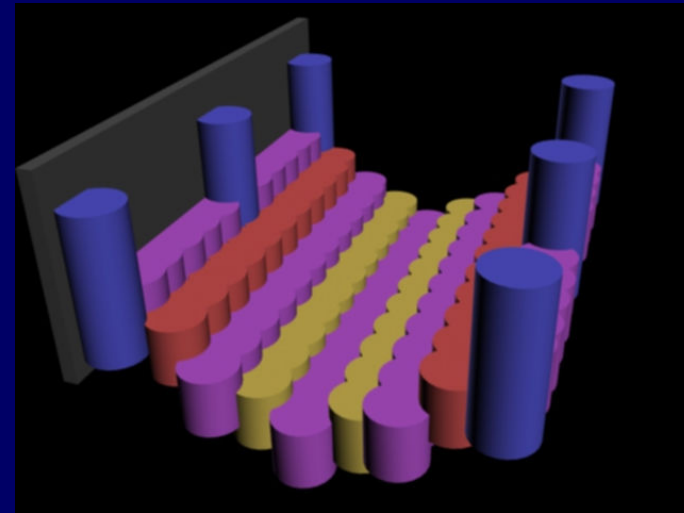


Uncertainty and unmanageability

- Innovative engineering design
- Massive leak during construction, threat of collapse
- Large delays and cost overrun



Changes to the groundwater shield



- Input from contracted actors: warnings for groundwater seal design
- Uncertainty: are the warnings sincere or strategic?
- Client decides to hold to the doubted design

Constraints in closing the uncertainty gap by increasing information available

- Principal-agent problem
 - Information asymmetry
 - Possible strategic behavior
- Flawed interpretation
 - 'Damage risk' and 'deviance risk'
- Preoccupations
 - Overvaluing of objective, quantifiable, measurable aspects (time, costs)
 - Overvaluing of time and costs as publicly visible aspects the client is accountable for

Possible solutions

- Discipline agents in providing information
- Discipline principals in interpreting information
- *In general: reconsider incentives*

- Outsourcing, including responsibility for end-result
- Increase the expertise of the client organization
- Adjust ambitions. Increasing information available brings dependencies and strategic interests into the project, so creates new uncertainties