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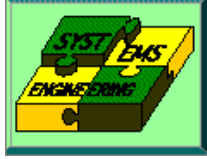


SYST 101: Intro to Systems

Lecture 20

Apr 1, 2004

C. Wells, SEOR Dept.

Agenda

- Discussion of Projects
- Petroski, Chapters 9
  - Lessons from “Bridges and Politics”

Bridges and Politics

- Petroski discusses
  - The various types of bridges
  - How they evolved
- How Competing Designs Are Selected
- How Long Term Projects Are Financed
- Tradeoffs Between User Communities

Look at the Need First

- Goal is to be able to move people and things across water from one place to another
- Many options
  - Tunnel
  - Causeway
  - Bridge
  - Barge/ferry
  - Cablecar
  - Air transport

Tradeoffs in Bridge Type Selection

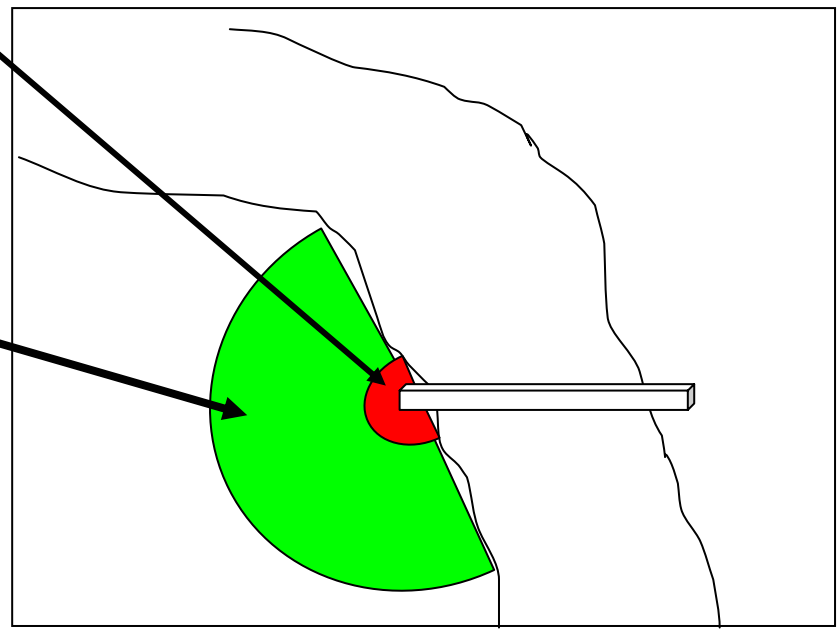
- Decision Tree
- Must Ship Traffic Travel the Waterway?
- Yes: Higher Bridge Span Height
  -> More Land Rqrd on Each End
- No: Lower Bridge Span Height
  -> Less Land Rqrd

Effect of Land Acquisition

- Folks on each side may want to visit each other
- But usually don't want their neighborhoods destroyed for a new bridge
- Same argument ongoing right now concerning the Wilson Bridge replacement and Alexandria land acquisition

User Communities

- Land Acquisition Affects Immediate Residents
- Bridge Benefits Larger Community



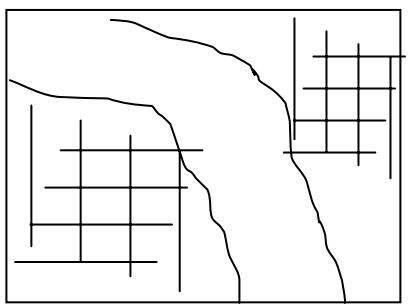
Benefit/Effects Assessment

- Effects on Traffic
  - Local to Bridge Ends
  - Regional
- Effects on Economies
  - Local vs Regional

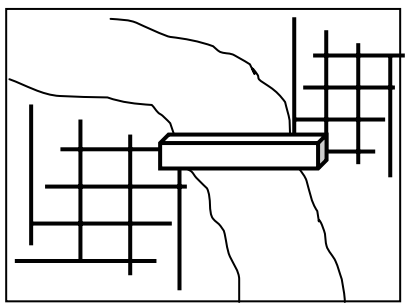
Network Modeling

- Traffic Modeling and Simulation
  - Very large and extensive models
- Model Traffic Flows

Before



After



Higher flows mean more pollution, Possibly higher economic activity, Possibly higher crime...

Tradeoff for Government

- Don't Build Bridge
  - Everyone somewhat unhappy with status quo
- Build Bridge
  - Large segment of constituents happier
  - Small segment of constituents much unhappier

Time Factors

- Bridges take forever to get built
  - Years in planning
  - Years in construction
- Funding is not assured over this extended period
  - Up front costs drive political decisions
  - Difficulty maintaining the momentum of support

Project Phases

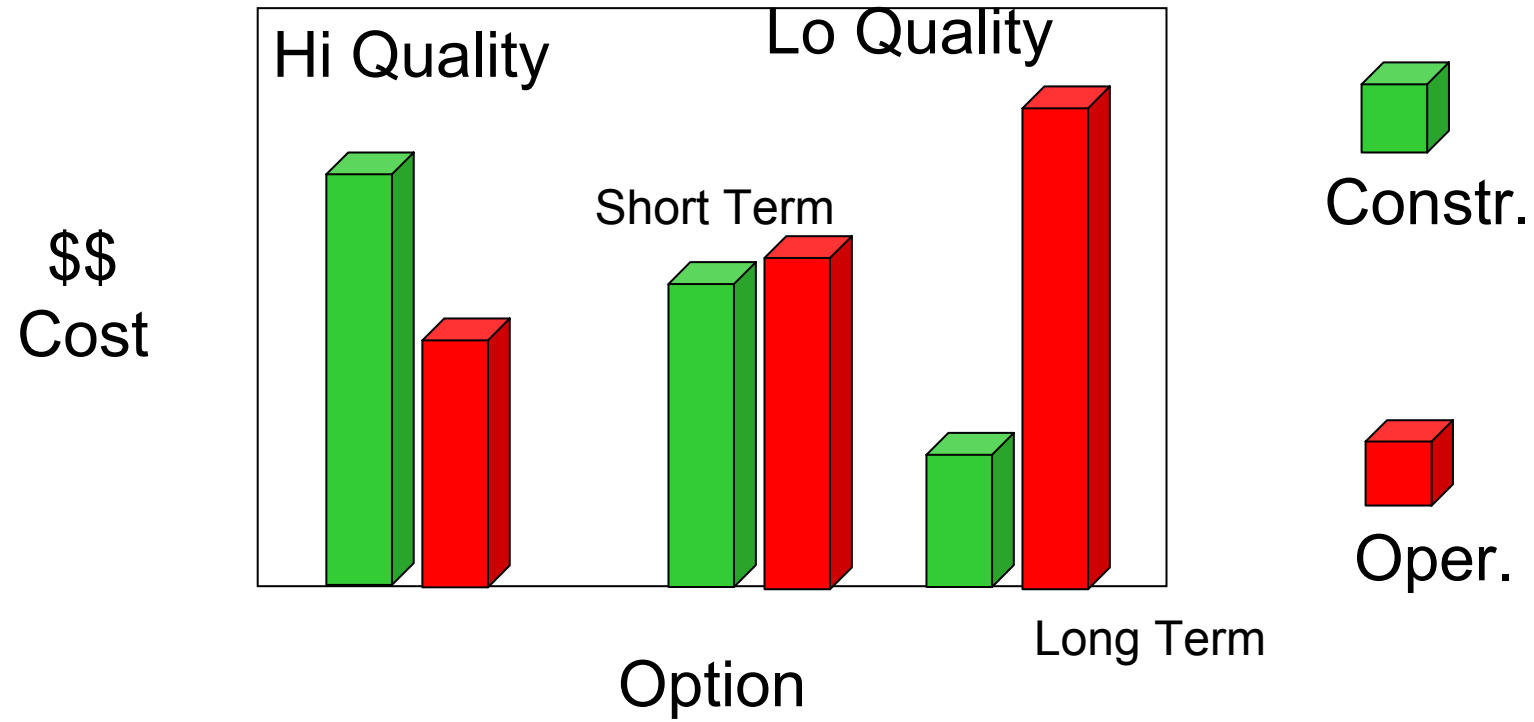
- Design Phase
  - Competitive Designs
  - Relatively Inexpensive
  - Relatively Little Opposition
  - Drives total costs
- Construction Phase
  - Must Have Only One Design
  - Expensive
  - Opposition Prior to Start

Project Phases (cont)

- Operations Phase
  - Income: Tolls?
  - Expenses:
    - Maintenance
    - Toll Booth Operator Salaries?
  - Another trade
  - Design/Construction Vs Operations
    - Use the best techniques and materials and you may have lower maintenance costs.

Construction/Maintenance Tradeoff

- Another classic tradeoff

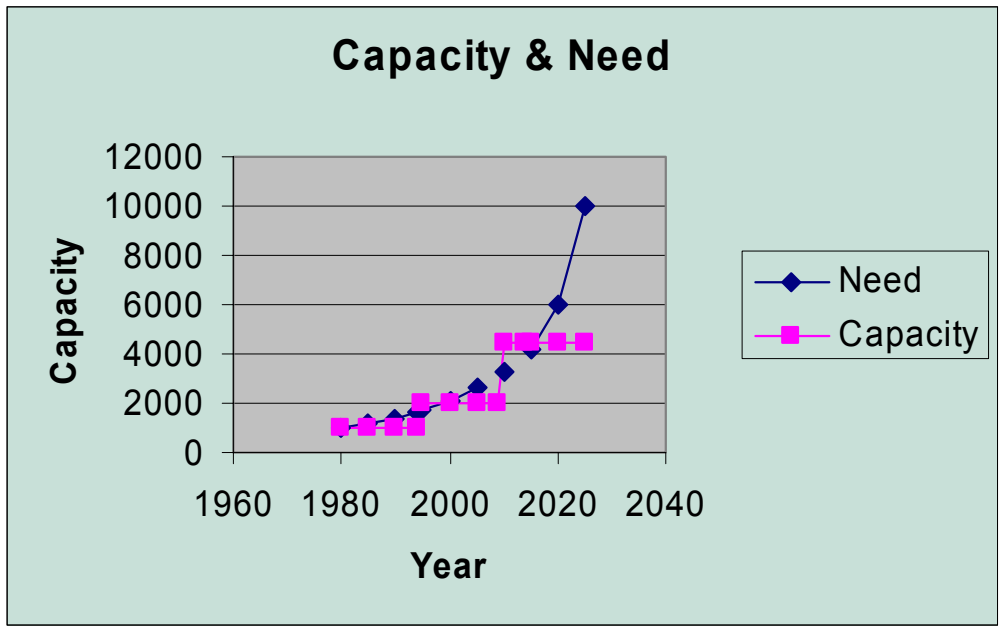


Project Phases (cont)

- Retirement/Replacement Phase
  - Retirement Usually Means Dismantling
  - Modern Bridges Usually Replaced
    - In Place or Nearby
  - The need for the bridge rarely disappears
    - Usually replaced to get additional capacity
    - Several points on the Mississippi River where the old bridge stands next to the new one

Capacity Vs Time

- Need for Additional Capacity Increases Faster than the Bridge Construction Time
- Need expands to fill capacity and then some
- Capacity is never sufficient



Summary

- Can't just go build a bridge....
- Design Tradeoffs
  - Local and regional impacts/benefits
    - Traffic density, pollution, economics, crime, taxes
- Construction
  - Maintain expected funding levels
- Operation & Maintenance
- Retirement & Replacement
  - You're pretty much stuck with a bridge forever...

Assignments

- Reading
  - Petroski, IBD, Ch. 10, “Buildings and Systems”
  - Petroski, EIH, Ch. 15, “Slide Rule to Computer”
- Homework
  - Consider the expansion of Metro to Dulles Airport.
    - perform a system trade to include routing
    - identify the final solution and give rationale for the decision