Bay Bridge New East Span

Costs:
• 2001 estimate incl. tower: $2.6B
• 2005 AB144/SB66 budget: $5.5B
• Final budget: $6.5B

Governance/Oversight:
• Caltrans
• Toll Bridge Program Oversight Committee (Caltrans, BATA, CTC)

Delivery challenges included:
• Debate on alignment and design
• Increases in materials costs
• Construction quality control

Post reviews:
• State auditor
Salesforce Transit Center

Costs:
- 2010 budget (incl. train box): $1.6B
- Final budget: $2.3B

Governance/Oversight:
- TJPA
- Cost Review Committee (SF, MTC, TJPA)

Delivery challenges included:
- Low/optimistic estimates
- Unfavorable bidding market
- Congested work area
- Fractured beams

Post reviews:
- Peer reviews and governance (MTC/ SFCTA)
Plan Bay Area 2040 Megaprojects

Transbay Terminal Phase 2 – Downtown Extension

- ~$4B
- >50% funds not committed
- Project owner and oversight?
- Pennsylvania Ave as Phase 3?
- Caltrain, High Speed Rail

Diridon Station Expansion

- Cost TBD
- High Speed Rail, Caltrain, ACE, Capitol Corridor, BART, VTA coordination
- Airport connection?
- VTA is RM3 project sponsor

California High Speed Rail Bay Area Segments

SF to SJ
- ~$2.4B incl. HSR funds for Caltrain Elect. and DTX
- Shared tracks with Caltrain

SJ to Gilroy
- ~$2.8B w/ at-grade Diridon
- Uses UPRR ROW

Express Lanes Network

- >$2B of potential projects in region
- $300M in RM3 funding
- San Mateo 101 starting construction
New Transbay Rail Crossing?

- Many $ billions
- No capital funding
- Route, tracks, operators?
- SF, East Bay connections?

Valley Link?

- ~$2B Phase 1
- ~$600M funding identified for corridor
- Megaregion operations?
- BART, ACE connections?

Dumbarton Rail?

- Southern Alameda Rail Analysis
- DB Corridor Study
- Technology, operator, cost?
- Peninsula, East Bay connections?

State Route 37?

- ~$5B
- Sea level rise, capacity?
- Tolling?
- Enhanced transit in corridor?
Other Recently Delivered Megaprojects

Successes and Lessons Learned
• Solid coordination from beginning
• Cooperative strategy for funding
• Laser and transparent focus on costs, including from funding partners
• Favorable bidding environment
Context and Challenges Ahead

- Construction costs *(highest on the planet?*)
- Fragmented governance
- Funding silos and limits
- Supportive land use and other policies
Megaprojects: A Major Challenge

Projects that are exceptionally costly, controversial, context-specific, challenging to design, complex to construct

• Often strain institutional capacities
• Takes skill to keep them from becoming catastrophic, career-ending
• Examples: Channel Tunnel, Eastern Span - Bay Bridge, London congestion pricing, many urban rail projects
Don’t despair over Transbay Transit Center cracks: Fix how we do megaprojects

By Gabriel Metcalf and Ratna Amin | October 4, 2018
How Politics and Bad Decisions Starved New York’s Subways

Disruptions and delays have roiled the system this year. But the crisis was long in the making, fueled by a litany of errors, a Times investigation shows.
How California’s faltering high-speed rail project was ‘captured’ by costly consultants
From $250 Million to $6.5 Billion: The Bay Bridge Cost Overrun
Track Record in California and U.S.

From a comparative international perspective:

• Poor performance according to traditional project delivery measures of cost and schedule

• Many recent projects have shown design flaws

• When considering transit and passenger rail projects, the approach to project delivery may be less holistic and there seems to be less of an emphasis on maximizing broader social benefits
Cost: $6.5B (2013)

Maximum height 525'

11,600’ long

Took 11 years to build

2,500% increase over initial estimate of $250M
How can we do better?
Viaduc de Millau

Tallest bridge in the world (1,104’)

8,200’ long viaduct

Took 3 years to build

France known for

- Bold land use planning
- Integrated transportation and development
- Political leadership
- Efficient project delivery entities
Strong regional approach to transit and land use

Transportation not an end in and of itself
Key Aspects of French Project Delivery

• Emphasis on public sector in-house expertise / capacity
• Strong regional approach to transportation and land use planning
• Governance models and planning processes at different geographic scales that
  • facilitate project implementation
  • maximize public benefits from transportation investments
• Holistic and cross-disciplinary approach to transportation investments and city building
The way in which we currently work together
• French station projects are typically led by small, cross-disciplinary governance entities formed in the initial stages of project development.

• They have high levels of in-house expertise on all topics related to station area development.

• This allows them to effectively direct all aspects of station area work.
French Station
Area Governance
Entities
Conception, Governance and Implementation of Rail Station Megaprojects
Learning from France

Eric Eidlin, Station Planning Manager
City of San Jose
SPUR San Francisco
May 2, 2019

Karen Trapenberg Frick
UC Berkeley Department of City and Regional Planning

Caroline Gallez
French Institute of Science and Technology for Transport, Development and Networks
Taking the High Road to More and Better Infrastructure, Including Mega Projects!

Dena Belzer
Strategic Economics
May 2, 2019
US Cities face an infrastructure and climate crisis

- $3.6 trillion by 2020 in basic infrastructure needed
- $188 billion in city weather damages in metro areas
- Most carbon emissions emanate from cities
- Affects competitiveness
- Opportunity for increased productivity and quality of life
- But standards are needed to elevate the right projects
Our Team Was Asked: How Do We Produce More and Better Infrastructure

- Project Lead
- Pre-Development activities, exchanges, infrastructure
- Pre-Development activities, municipal finance, case studies
- Investors and pension funds
- Federal policy and engagement
- Case studies, blended capital funds
- Case studies, blended capital funds
What We Found: When We Plan Infrastructure, We Usually Plan *(and pay for)* One System at a Time

- Transportation
- Parks
- Affordable Housing
- Community Clinics
- Sidewalks and Bike Lanes
What’s the Result of This Approach: Low Road Infrastructure

Single purpose projects that get built without considering externalities, life cycle costs, or community impacts.

Black Bottom neighborhood of Detroit being cleared for to make way for I-75 and I-375.
The High Road Approach:

Redefining Infrastructure Projects to Include a More Diverse Set of Outcomes that Amplify/Extend Project Benefits, While Saving Money in the Long Run

Conventional Infrastructure

High Road Infrastructure
High Road Infrastructure Funding/Financing Does Two Things Differently Than Conventional Infrastructure Planning and Delivery

1. **Expects every infrastructure project to deliver benefits in 4 areas:**
   - Environmental Improvements
   - Resiliency
   - Social and Economic equity
   - Governance and Community Accountability

2. **Use a High Road Predevelopment Process to Deliver Infrastructure Projects**
   - Establishes a community framework
   - Identifies a High Road project pipeline
   - Uses innovative funding, financing and procurement
Clean Water Program & Masdar City Program
Overview

May 2, 2019
What is the Clean Water Program?

The Clean Water Program is a comprehensive plan to upgrade the aging wastewater collection and treatment systems with advanced infrastructure that will provide reliable services for decades to come.

The goals of the Clean Water Program are to:

- **Replace** aging infrastructure and facilities
- **Build** wet weather sewer system capacity assurance to prevent overflows
- **Meet** current and future regulatory requirements
- **Align** with the City of San Mateo and Foster City’s sustainability goals
CWP uses a Program Management Delivery Platform – *Just In-Time Services, Commitment, Strategies & Expertise, Right Fit to Ensure Success*

Program Management Delivery Platform
- 2014
- 2016
- 2018
- 2024

Program Manager; Program Controls; Procurement; PMs & CMs

Project Management Delivery Platform
- Project Managers; Public Outreach; Environmental; Risks/Change Manager

Construction Management Delivery Platform
- Construction Managers; Project Managers; 3rd Parties; Inspectors

“Project Managers are at the Center of the Program Universe Model”
Technology Innovations – Allows Complete Water Flow Management Year Round that saves $150 million over Traditional Approaches
Innovation – Project Bundling, Sequencing and Technology Innovations allowed Program to be Done in 10 Years

Original Master Plan Approach

20 Years – $1.2 Billion
12% average rate increases

CWP Programmatic Approach

10 Years – $1 Billion
10% average rate increases

Approximately $200 million savings by compressing from 20 to 10 Years
Masdar City’s Approach to a Sustainable City

Masdar City Fast Facts

- Total Site Area: 700 ha
- Large Square: 225 ha
- Small Square: 55 ha
- Supporting Infrastructure: 45 ha
- Landscape: 37 ha
- Resident Population: 40,000
- Commuters: 50,000

Residential Density: 1.60 People/hectare
Peak Daily Density: 245 People/hectare
At Masdar City - The Old Way Isn’t Going to Work

Water-Energy-Carbon Nexus

What it was... Water  Energy  Carbon

What it is...  

What it is becoming

New thinking – Using carbon as currency vs. $ for Technology Selections

"This really is an innovative approach, but I'm afraid we can't consider it. It's never been done before."

JACOBS
Masdar City’s Thinking based on Mega Trends

Mega Trends Globally

Rapid Urbanization

Environmental Improvement

Social Citizenship

Future Cities

Compact  Integrated  Resource Efficient  Sustainable

Innovation Focus Areas

Solid State Lighting  Sustainable Data & City Operations  Management

Intelligent Transportation System  Monitoring  W-E-C Nexus  Behavior Changes

Solar/Thermal Heating & Cooling  Security  Green Supply Chain  Smart Grid/Buildings

CH2M-Masdar City 2010

JACOBS
New Thinking Is Needed To Manage The Water-Energy-Carbon Nexus In Digital Smart Cities

Conventional Water Treatment Is Energy Intensive

Innovations Needed:
- Resource Recovery
- Novel Technology Breakthrough
- Utilize Excess Capacity
- Change from “Waste” to Resource Thinking

Stovepipe City Planning & Operations

Innovations Needed:
- Resource Balancing
- Total Integration & Balance
- One Waste is Another’s Building Block
- Behavior Change Drivers

Accepting Past Practices

Innovations Needed:
- Resource Management
- Savings with Innovations
- Active & Passive Systems Alignment & Effectiveness

Drone Cloud to Cool Playing Field
Working from multiple angles to answer the question: What can achieve that is sustainable, commercially viable, and retains the Masdar City brand?
The Sustainable City

Energy Management

Wastewater Management

Solids Management

Water Management

Masdar City’s Integrated Voyage Model Manages Supply & Demands
Masdar City’s Technology Innovations Roadmap Process

- Finalise business case for CAPEx
- Define KPI’s for Pilot
- Finalise business case for bundled options (20-6-2)
- Define KPI’s for Pilot

1. Start
- Model and validate targets (CO2e, etc)
- Determine integration touch points

2. Need
- Report defines the gaps
- Define possible technological solutions

3. Gaps
- MCA scoring on possible technologies (102-31)
- Evaluate and long list the solutions (31-20)

4. Mix
- Lifecycle Analysis
- Measure KPI’s

5. Integration
- Business Case
- Supply & Demand

6. Model
- Long-list Evaluation (MCA)

7. TBL analysis based on SMS
- Model and validate targets (CO2e, etc)

Source: McKinsey, CH2M HILL, ADFEC
Masdar City Roadmaps Since 2007

City Roadmaps Completed Since 2007:

- On-Site Groundwater Study
- International PV Competition
- Double Effect Thermal Chiller Demonstration
- Brine Management, Treatment, and Revenue Study
- Desalination Groundwater Study (Pending)
- Geothermal Demonstration and Well
- Wind Tunnel Micro-Climate Study
- Waste Management Design and Operations Competition
- Integrated Waste Management Model
- Vacuum Waste Study
- Energy Thermal Piles Demonstration
- Grey Water Pilot
- CPV Competition (Pending)
- Smart Home Appliances Demonstration (Pending)
- Low Carbon Concrete Competition and Prize
- Sustainability Management System Tracking Tool
- Integration Asset Class Model
- Tokyo Solar/Thermal Pilot
- Small Scale Waste to Energy Demonstration (Pending)
- 10 MW Solar PV Farm & Smart ICT Living Laboratory

Geothermal Demonstration
Grey Water Demonstration
Linear Fresnel & Double Effect Thermal Chiller Demonstration
Tokyo Solar – Thermal Pilot
Concrete’s many green benefits make it the sustainable choice.
10 MW Solar PV Farm
Green Concrete Competition
How can we build megaprojects right?

SPUR

Presentation | May 2, 2019
Our research indicates that while poor execution is the most common culprit, market and organizational problems can lead to the most significant delays.

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency (% of projects)</th>
<th>Average Overrun</th>
<th>Average Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>Evaluate technical definition of all scope elements including definition of feedstock, reservoir, ore body, fluids, etc</td>
<td>46%</td>
<td>40%</td>
</tr>
<tr>
<td>Execution</td>
<td>Review schedule, budget, major project phases, resource capacity, KPI’s, health, safety, environmental practices, and logistics</td>
<td>73%</td>
<td>37%</td>
</tr>
<tr>
<td>Market</td>
<td>Assess financial health, contracting strategy, financing options, pricing, and check stress scenarios</td>
<td>40%</td>
<td>42%</td>
</tr>
<tr>
<td>Political</td>
<td>Understand status of permitting and approvals, stakeholder management, local engagement programs and land acquisition</td>
<td>27%</td>
<td>38%</td>
</tr>
<tr>
<td>Organizational</td>
<td>Assess owner capabilities, governance, inter-agency coordination, management protocols, labor strategy, and RACI</td>
<td>65%</td>
<td>41%</td>
</tr>
</tbody>
</table>

SOURCE: McKinsey analysis of failure root causes for megaprojects across industries
### Why projects go wrong: 10 most critical areas, based on our experience with over 100 mega-projects

<table>
<thead>
<tr>
<th>Critical areas</th>
<th>Typical signs of trouble</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common understanding of situation</td>
<td>No &quot;single version of the truth&quot;</td>
</tr>
<tr>
<td>Contractor management</td>
<td>Using only general measures without much insight</td>
</tr>
<tr>
<td>Connection between plan and actual activities</td>
<td>Measuring mainly non-critical elements</td>
</tr>
<tr>
<td>Anticipatory planning</td>
<td>Little/no adherence to the overall plan, as this leads to each working unit optimizing only for themselves</td>
</tr>
<tr>
<td></td>
<td>Only boilerplate reporting rather than targeted weekly updates that reflect wins and losses in momentum and shifting bottlenecks</td>
</tr>
<tr>
<td>Active risk management</td>
<td>Outdated project risk register and focus only on obvious risks rather than more specific shifting risks</td>
</tr>
<tr>
<td>Credibility of forecasts</td>
<td>Required rate differs from current trajectory</td>
</tr>
<tr>
<td>Performance management</td>
<td>Expected progress doesn’t slow considerably as project advances</td>
</tr>
<tr>
<td>Contract constraints</td>
<td>No visual management and actions are not logged and tracked daily</td>
</tr>
<tr>
<td>Sufficient muscle on Owner’s team</td>
<td>No clear understanding of contracts by Owner’s team</td>
</tr>
<tr>
<td>People</td>
<td>Weak cost control and reimbursement management</td>
</tr>
<tr>
<td></td>
<td>No tight coverage between reps and the contractor leads</td>
</tr>
<tr>
<td></td>
<td>No continuity with pivotal players, especially on contractor side</td>
</tr>
</tbody>
</table>
Owners systematically underappreciate the risks of megaprojects and often end up eroding value during execution

Key elements of successful value protection

<table>
<thead>
<tr>
<th>Cost optimization</th>
<th>Risk mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Rigorous selection of design/value tradeoffs</td>
<td>▪ Honest, critical evaluation of risks in the project across all sources</td>
</tr>
<tr>
<td>▪ Analysis of project through Total Cost of Ownership (TCO) lens</td>
<td>▪ Cross-stakeholder engagement to anticipate and mitigate risks (e.g. public meetings to raise and address community issues)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Financing planning</th>
<th>Schedule protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Scrutiny of business case, sources of revenue and associated risks</td>
<td>▪ Thorough pressure-testing of pre-construction and construction timelines to ensure they are both aggressive and achievable</td>
</tr>
<tr>
<td>▪ Alignment of project development and financing timelines</td>
<td>▪ Deployment of “lean” tools to reduce schedule delays and hit opening target</td>
</tr>
<tr>
<td>▪ Clear articulation of owner’s objective function (e.g., citizen benefit, commissioning of asset)</td>
<td></td>
</tr>
</tbody>
</table>
MINDSETS: The art of project leadership

Lead as a business, not as a project
An ultra-large project is more akin to building a business than executing a construction project, requiring CEO-level leadership and judgment to address a broad range of organizational issues.

Take full ownership of outcomes
The project owner needs to maintain full accountability for delivery. They must remain well informed throughout and be ready to step in to make tough decisions in a timely manner.

Make your contractor successful
Owners and contractors work best as a business partnership with a mindset of “we win together or lose together”. Productive contractor-owner relationships are based on mutual trust and joint problem solving.

Trust your processes, but know that leadership is required
Processes alone will not resolve every challenge on an ultra-large project. Leaders should trust and enforce the appropriate process, but recognize their benefits and limitations.
PRACTICES – Project setup

Define purpose, identity and culture
Effective project teams have a unique and shared identity, and create a culture of mutual trust and collaboration. Project leaders should articulate purpose, role model behaviors, and nourish the desired culture.

Assemble the right team
Besides shared values, owner and contractor team members need to have the appropriate blend of leadership qualities, cultural and local awareness for the task ahead. This must complement the requisite technical skills and experience.

Carefully allocate risk and align incentives
Successful owners thoughtfully delegate only those risks that the contractor is better positioned to manage. Leaders should establish and maintain relationships, not only contracts, to facilitate ongoing alignment of incentives.

Work hard on relationships with stakeholders
Strong and transparent trust-based relationships with stakeholders enable prevention and rapid resolution of problems. Invest in stakeholder management as a core activity.

Invest in your team
Delivering an ultra-large project requires continual investment in the effectiveness of the team. Leaders must think deeply about how to develop and challenge their people throughout.

Ensure timely decision making
Timely decision making depends on the delegation of decisions to the lowest appropriate level. To achieve this, leaders must have confidence and trust in their systems and people. Leaders are then free to resolve and anticipate critical issues.

Adopt forward looking performance management
Effective project leaders use fact-based performance dialogues to strengthen trusting relationships and instill accountability. This allows for early problem resolution and opportunity identification.

Drive desired behaviors consistently
Effective project leaders inspire their teams—especially in challenging times. They define, communicate, and role model expected attitudes and behaviors. Leaders should take the time to connect with team members on a personal level.