How Can We Build Megaprojects Right?

Alix Bockelman
Deputy Executive Director, Policy
Metropolitan Transportation Commission

SPUR San Francisco
May 2, 2019

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)

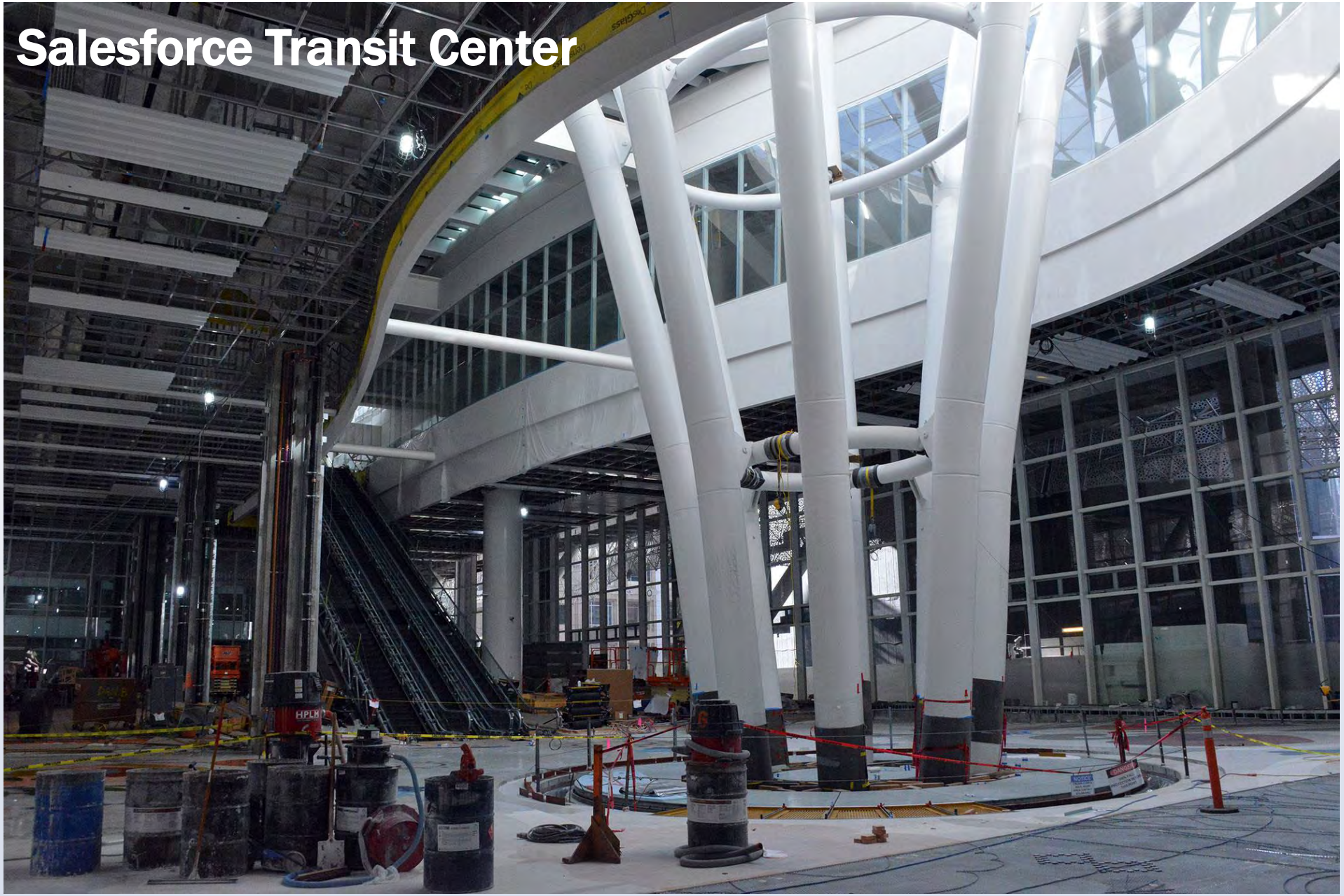
Delivery challenges included:

- 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

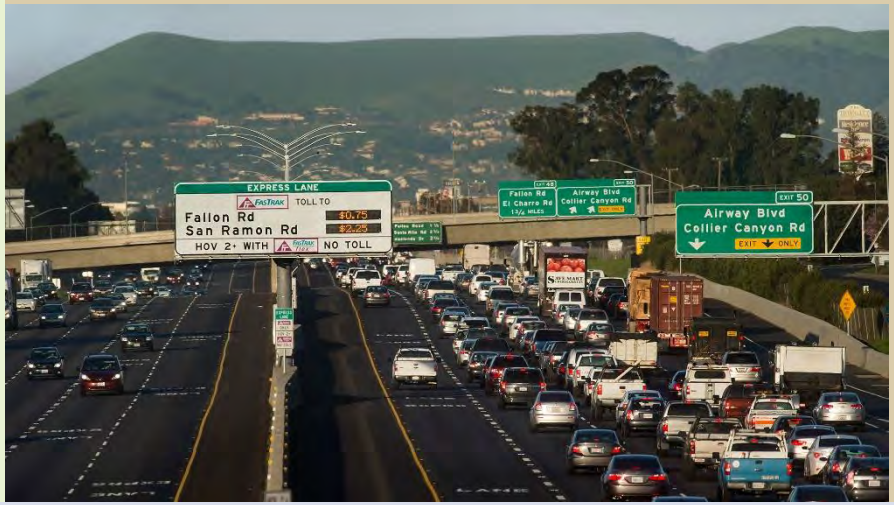
SF to SJ

- ~$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

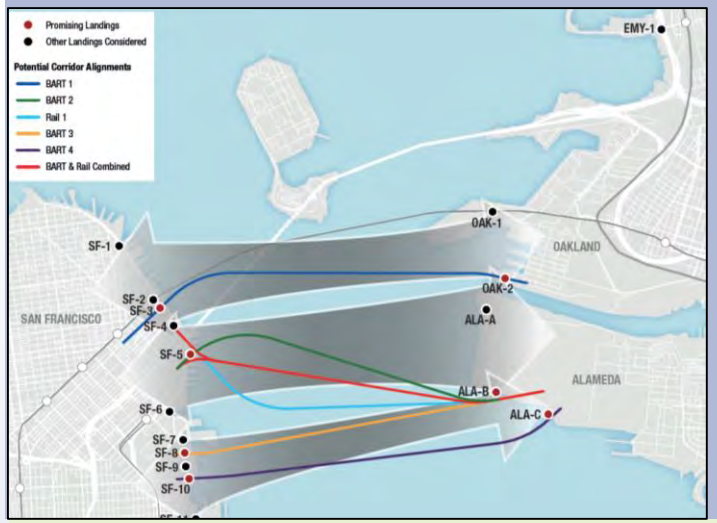
Express Lanes Network



- >$2B of potential projects in region
- $300M in RM3 funding
- San Mateo 101 starting construction

Looking Ahead – Potential Upcoming Megaprojects

New Transbay Rail Crossing?



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

Dumbarton Rail?

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

Valley Link?

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

State Route 37?

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

Other Recently Delivered Megaprojects


E-BART + SR 4 Widening ($1 billion)

BART to Warm Springs ($890 million)

Caldecott Tunnel 4th Bore ($417 million)

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

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

SPUR · MTI Mineta Transportation Institute · Department of City and Regional Planning, University of California – Berkeley · IFSTTAR · AREP · City of San Jose, Capital of Silicon Valley · Metropolitan Transportation Commission

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

San Francisco Chronicle

Don’t despair over Transbay Transit Center cracks: Fix how we do megaprojects

By Gabriel Metcalf and Ratna Amin | October 4, 2018

FILE - In this file photo taken Aug. 15, 2018, food trucks line up outside the new Transbay Transit Center in San Francisco. San Francisco officials shut down the city's $2.2 billion transit terminal Tuesday, Sept. 25, 2018, after a crack was found in a steel beam. (AP Photo/Lorin Eleni Gill, File)

... more

November 18, 2017

SYSTEM FAILURE

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.

The New York Times

Los Angeles Times

How California's faltering high-speed rail project was 'captured' by costly consultants

By RALPH VARTABEDIAN APR 26, 2019 | 11:30 AM

The new eastern span of the San Francisco-Oakland Bay Bridge seen on September 3, 2013. // REUTERS/Stephen Lam

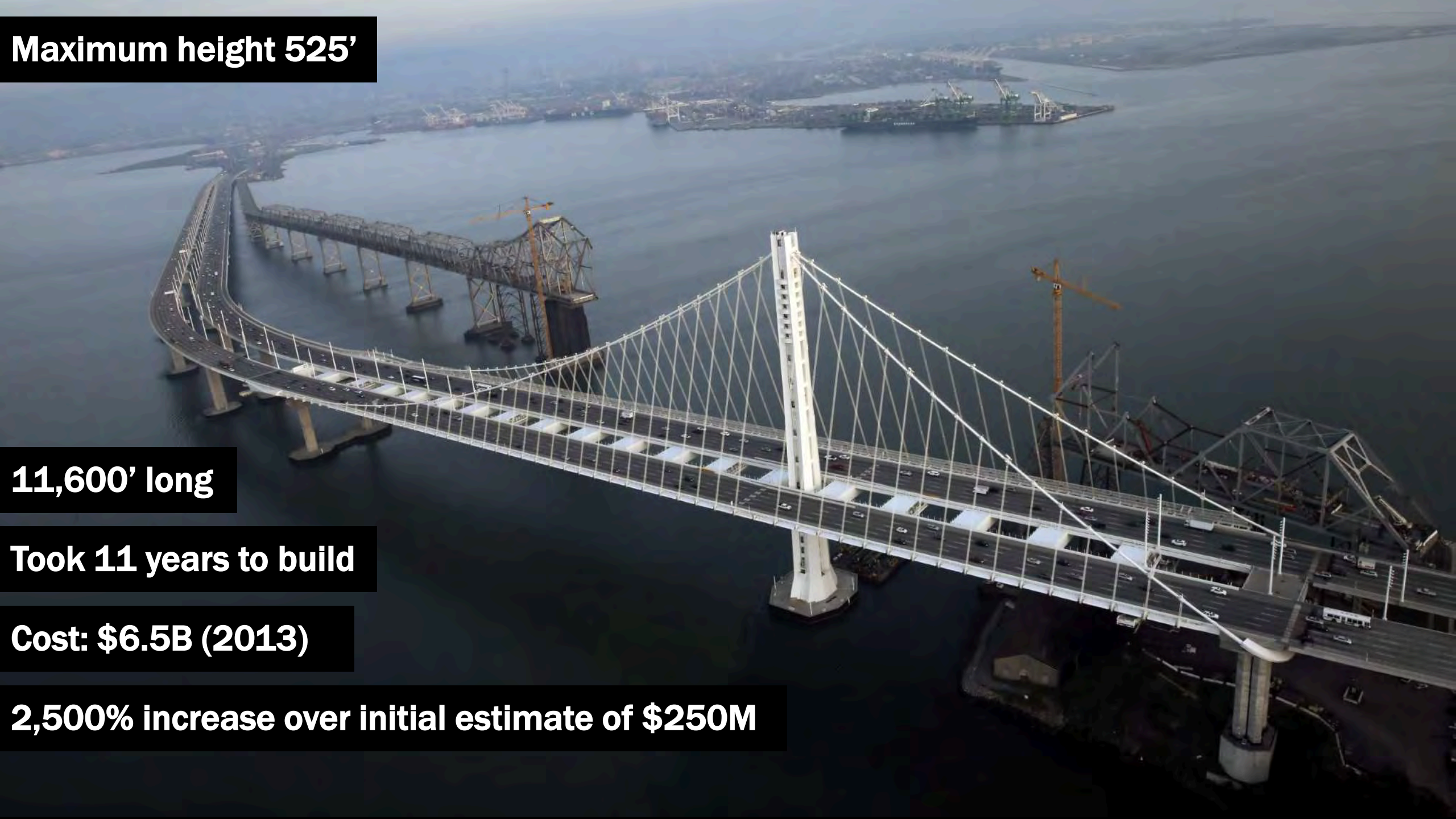
From $250 Million to $6.5 Billion: The Bay Bridge Cost Overrun

ERIC JAFFE OCT 13, 2015

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


Maximum height 525’
11,600’ long
Took 11 years to build
Cost: $6.5B (2013)
2,500% increase over initial estimate of $250M

How can we do better?


Tallest bridge in the world (1,104’)
8,200’ long viaduct
Took 3 years to build
Cost: $524 M (2004)
Stefan Krause
Viaduc de Millau

France known for

Bold land use planning

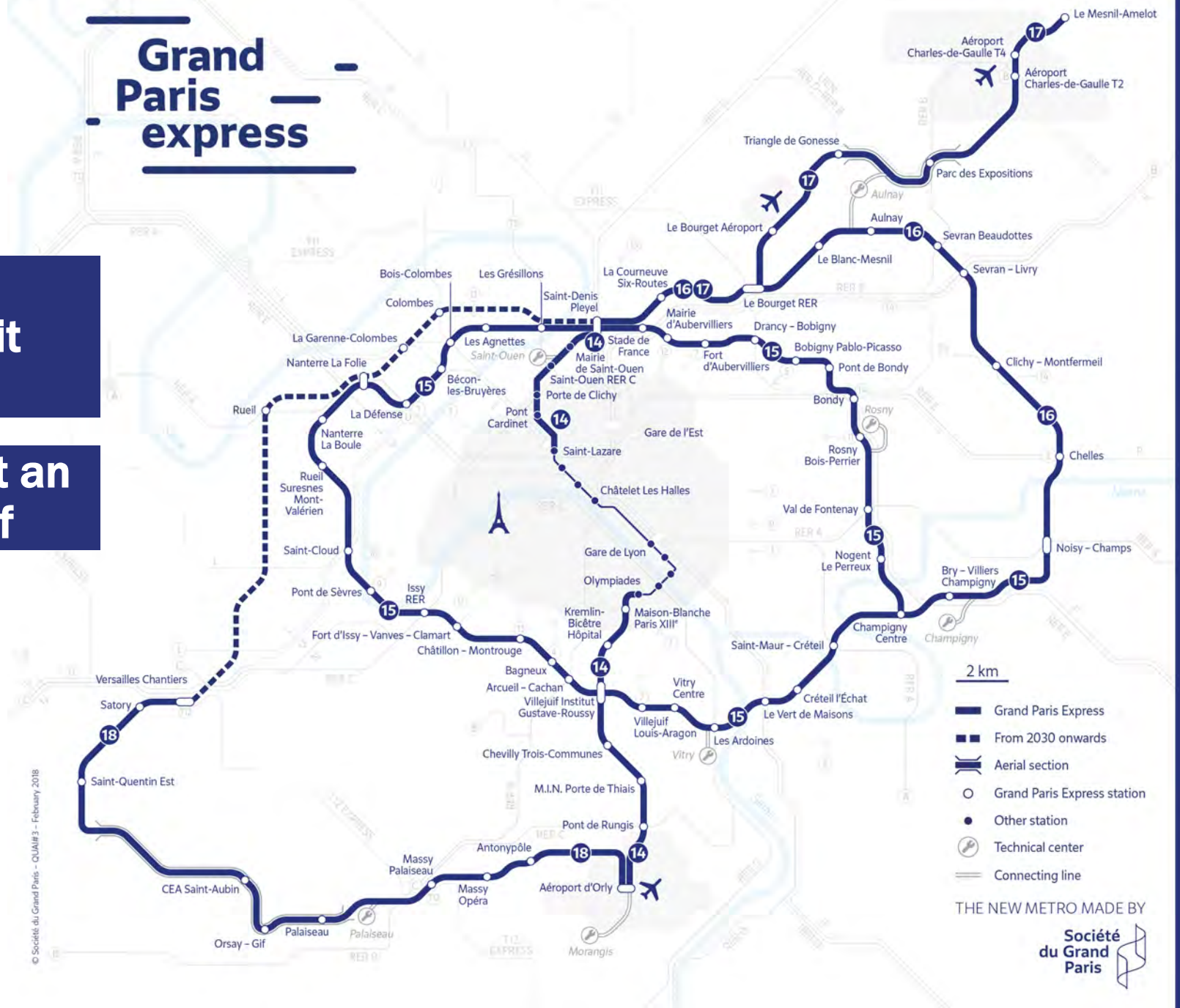
Integrated transportation and development

Political leadership

Efficient project delivery entities

Strong regional approach to transit and land use

Transportation not an end in and of itself

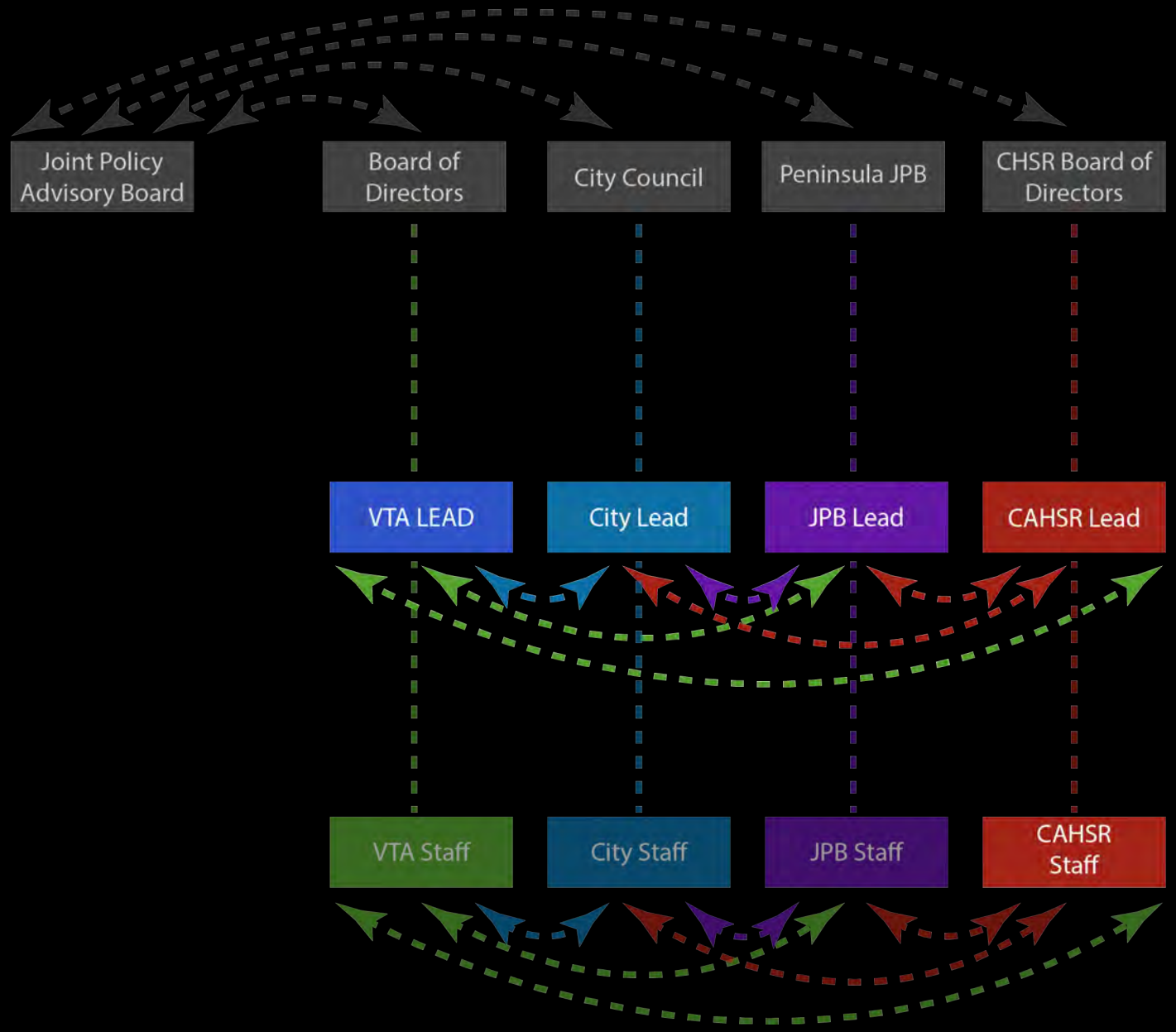


Opening

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

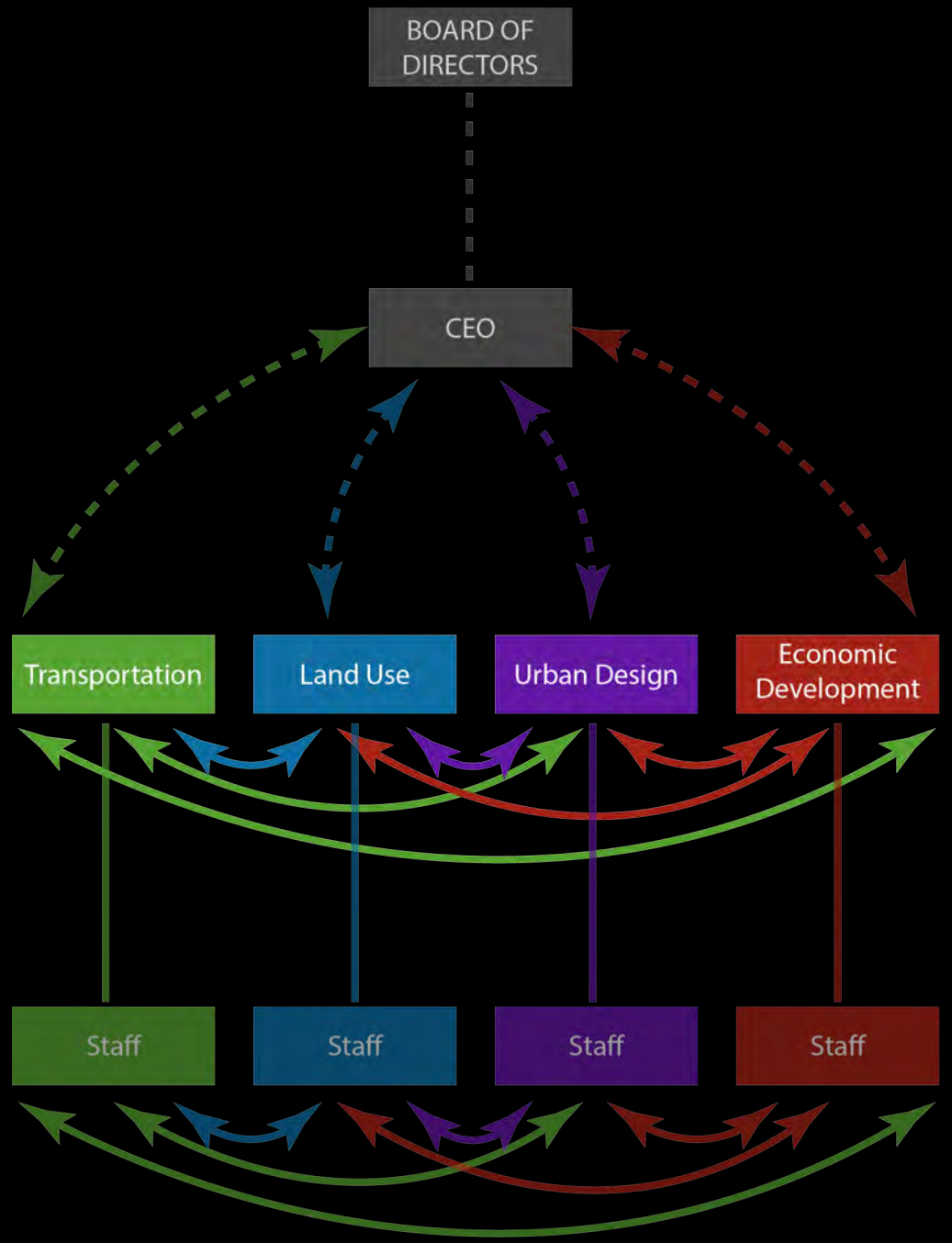
The way in which we currently work together



Bordeaux-Euratlantique

- 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



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Taking the High Road to More and Better Infrastructure, Including Mega Projects!

Dena Belzer
Strategic Economics
May 2, 2019

STRATEGICECONOMICS

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

What's the Result of This Approach: Low Road Infrastructure

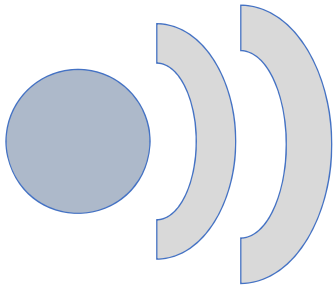
Single purpose projects that get built without considering externalities, life cycle costs, or community impacts

Black Bottom neighborhood of Detroit being cleared for to make way for I-75 and I-375

STRATEGICECONOMICS

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

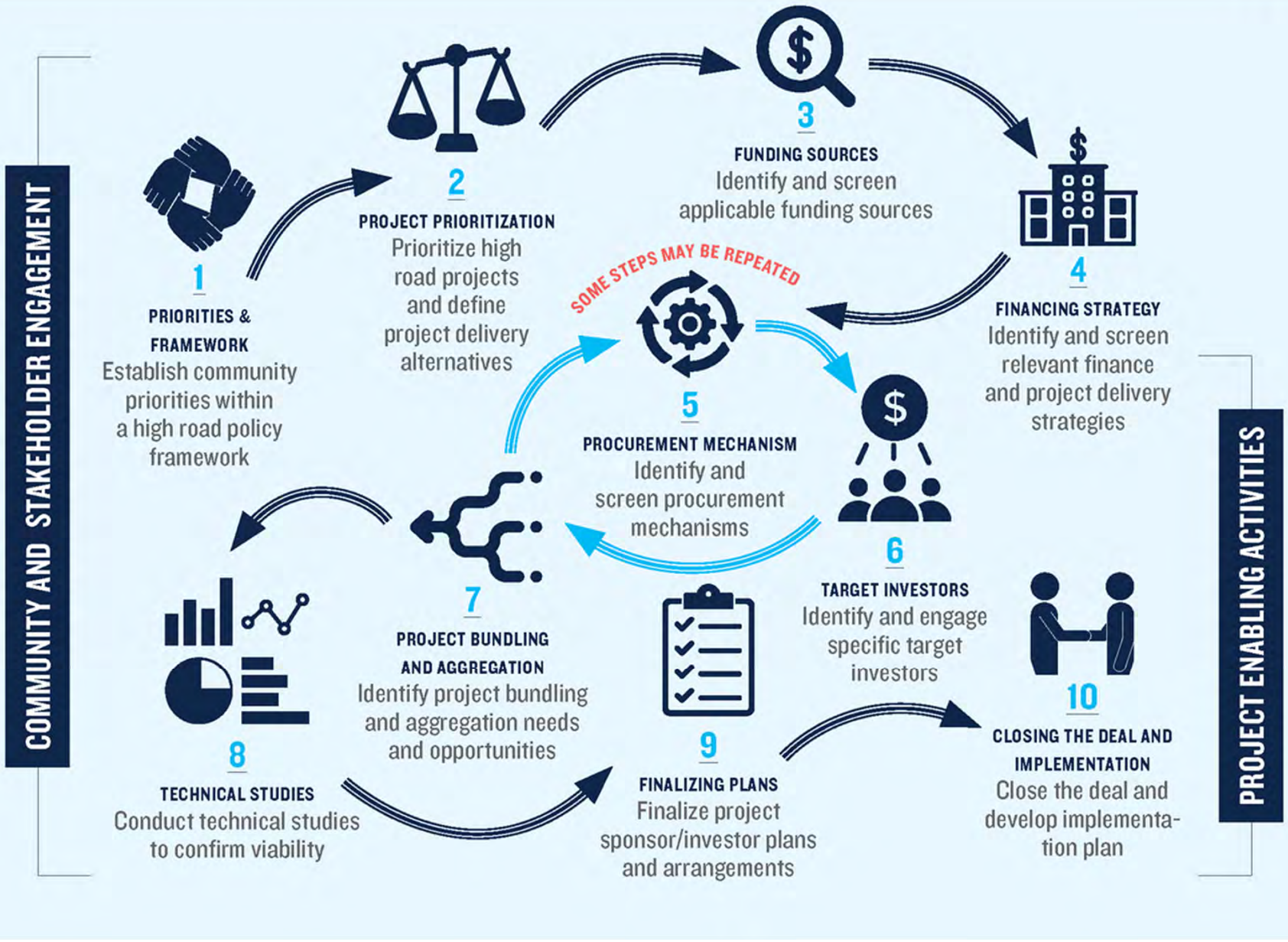
STRATEGICECONOMICS

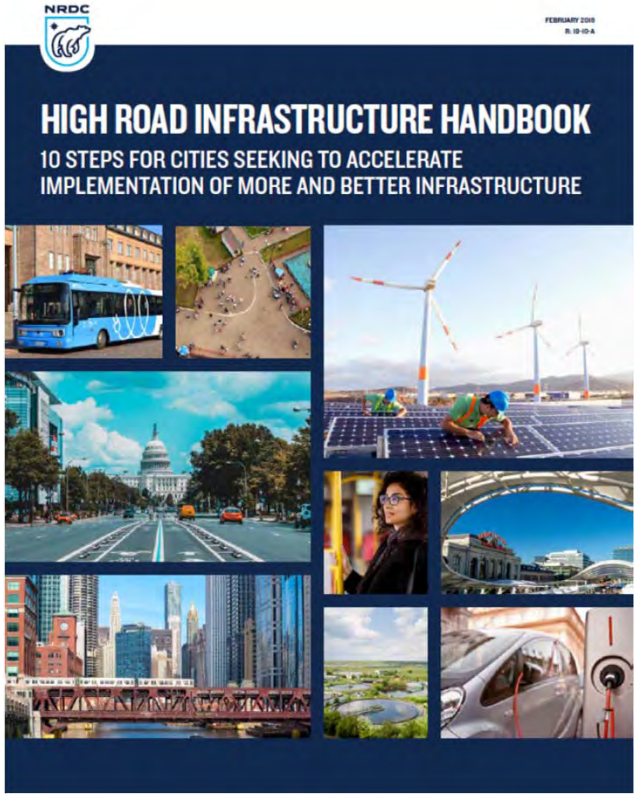
High Road Infrastructure Funding/Financing Does Two Things Differently Than Conventional Infrastructure Planning and Delivery

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

HIGH ROAD PREDEVELOPMENT MAP





https://www.nrdc.org/sites/default/files/high-road-infrastructure-handbook.pdf

STRATEGICECONOMICS

2019 San Mateo CWP Team

Clean Water Program & Masdar City Program Overview

May 2, 2019

Masdar City Team

www.jacobs.com | worldwide

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

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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"

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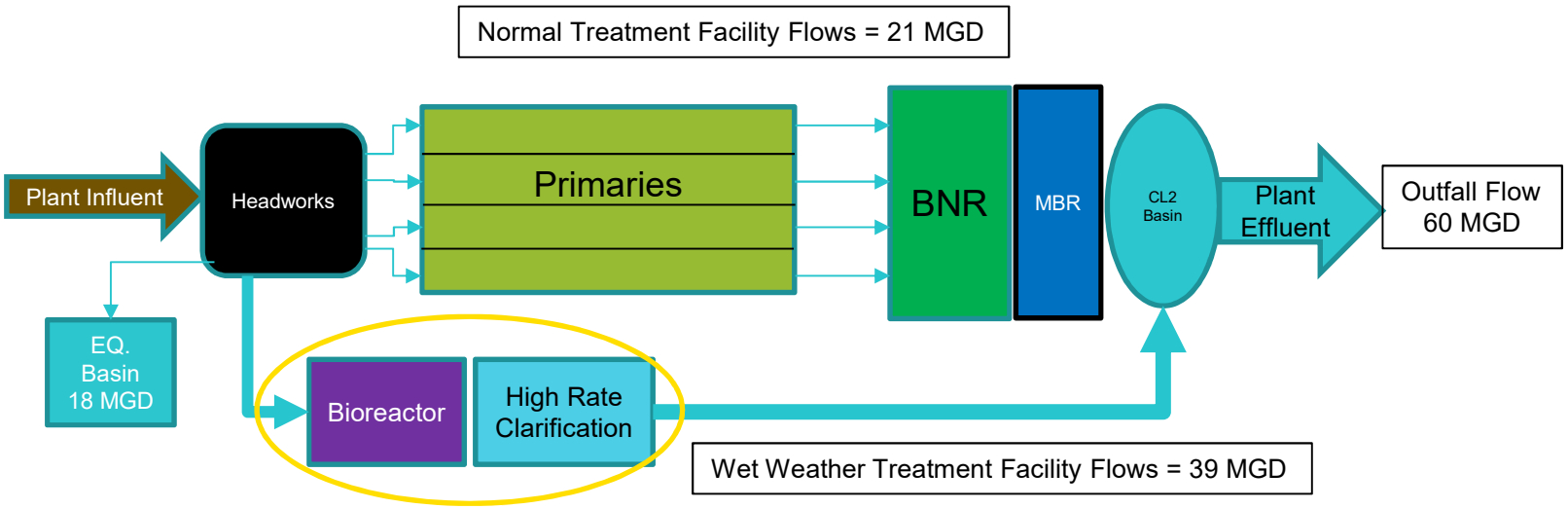
Technology Innovations – Allows Complete Water Flow Management Year Round that saves $150 million over Traditional Approaches



Bioreactor/HRC facilities maximize City's investment and prevents blending events

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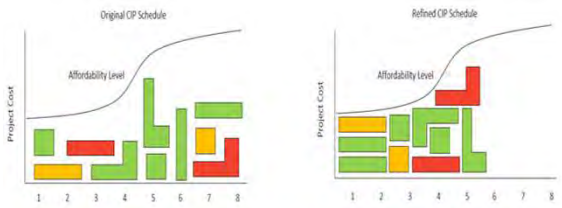
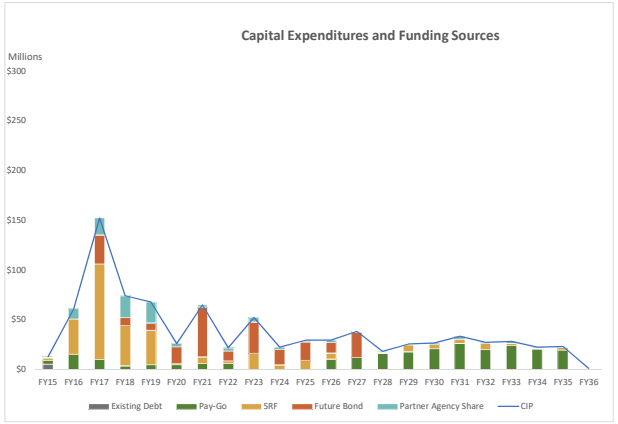
Innovation – Project Bundling, Sequencing and Technology Innovations allowed Program to be Done in 10 Years



Project Bundling & Sequencing

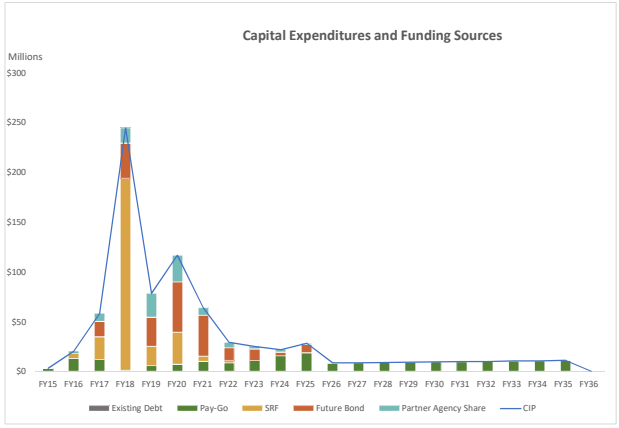
Original Master Plan Approach

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

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Masdar City's Approach to a Sustainable City

Masdar City Fast Facts	
Total Site Area:	700 ha
Large Square: Small Square: Supporting Infrastructure: Landscape:	225 ha 55 ha 45 ha 375 ha
Resident Population:	40,000
Commuters:	50,000
Residential Density:	140 People/Hectare
Peak Daily Density:	245 People/Hectare

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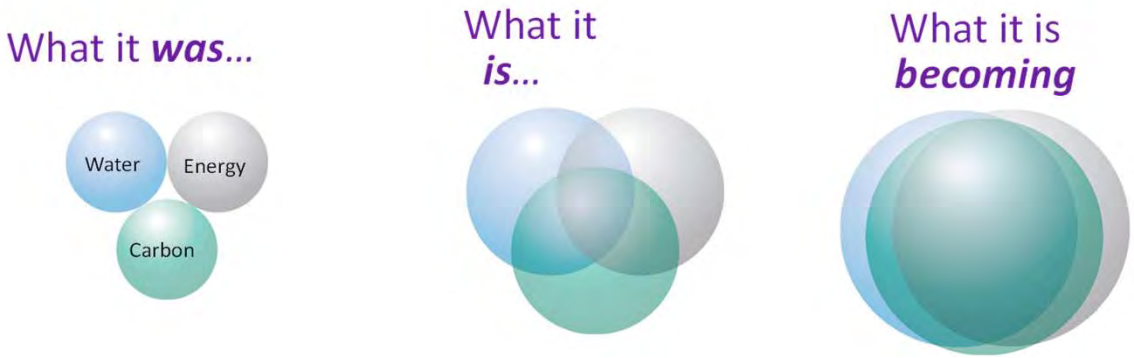
At Masdar City - The Old Way Isn't Going to Work



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

Water-Energy-Carbon Nexus

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

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Masdar City's Thinking based on Mega Trends

Mega Trends Globally

- Rapid Urbanization
- Environmental Improvement
- Social Citizenship

Future Cities

Compact | Integrated | Resource Efficient | Sustainable

CH2M-Masdar City 2010

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

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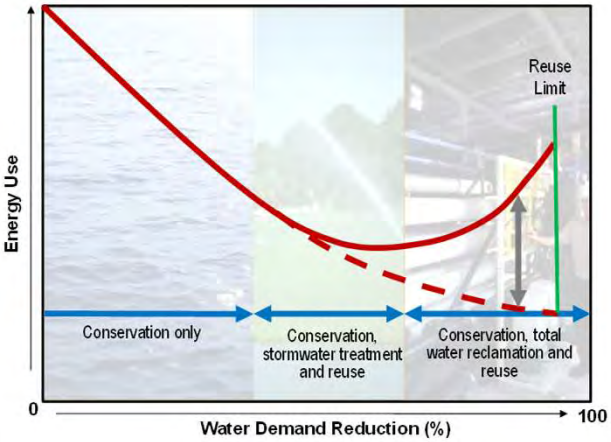
New Thinking Is Needed To Manage The Water-Energy-Carbon Nexus In Digital Smart Cities

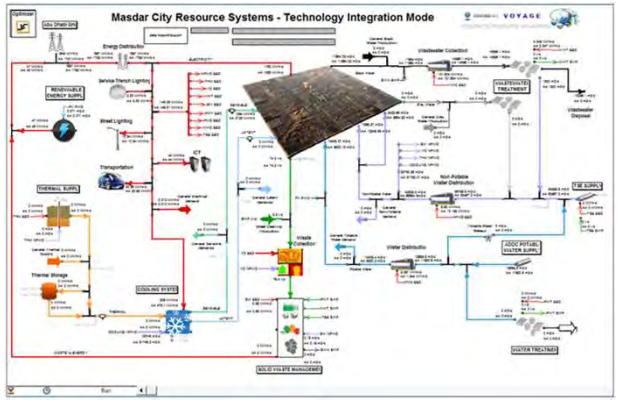
Conventional Water Treatment Is Energy Intensive



Innovations Needed:

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

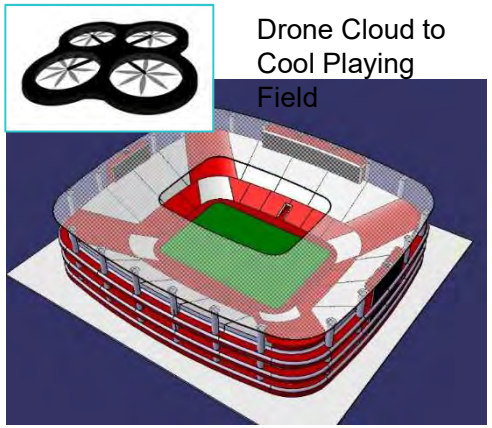
Stovepipe City Planning & Operations



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

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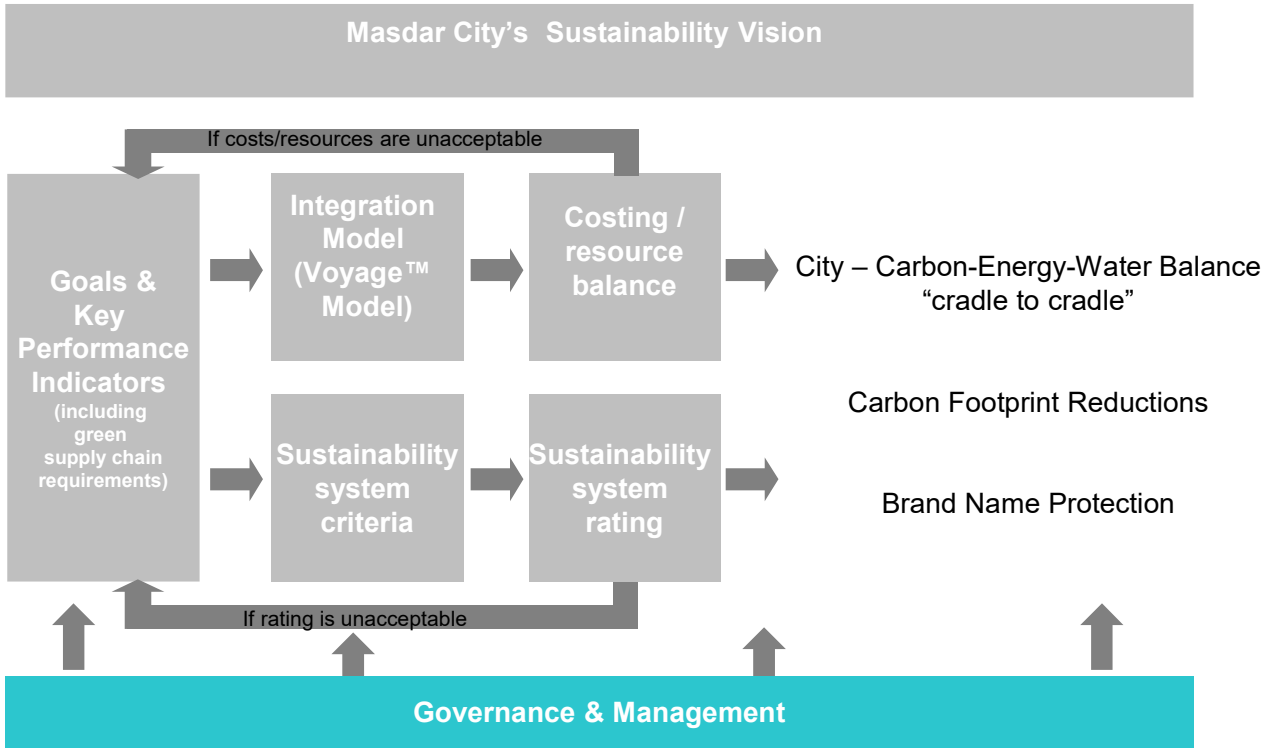
CH2M-Masdar City-Qatar2020FIFA

Working from multiple angles to answer the question: What can achieve that is sustainable, commercially viable, and retains the Masdar City brand?



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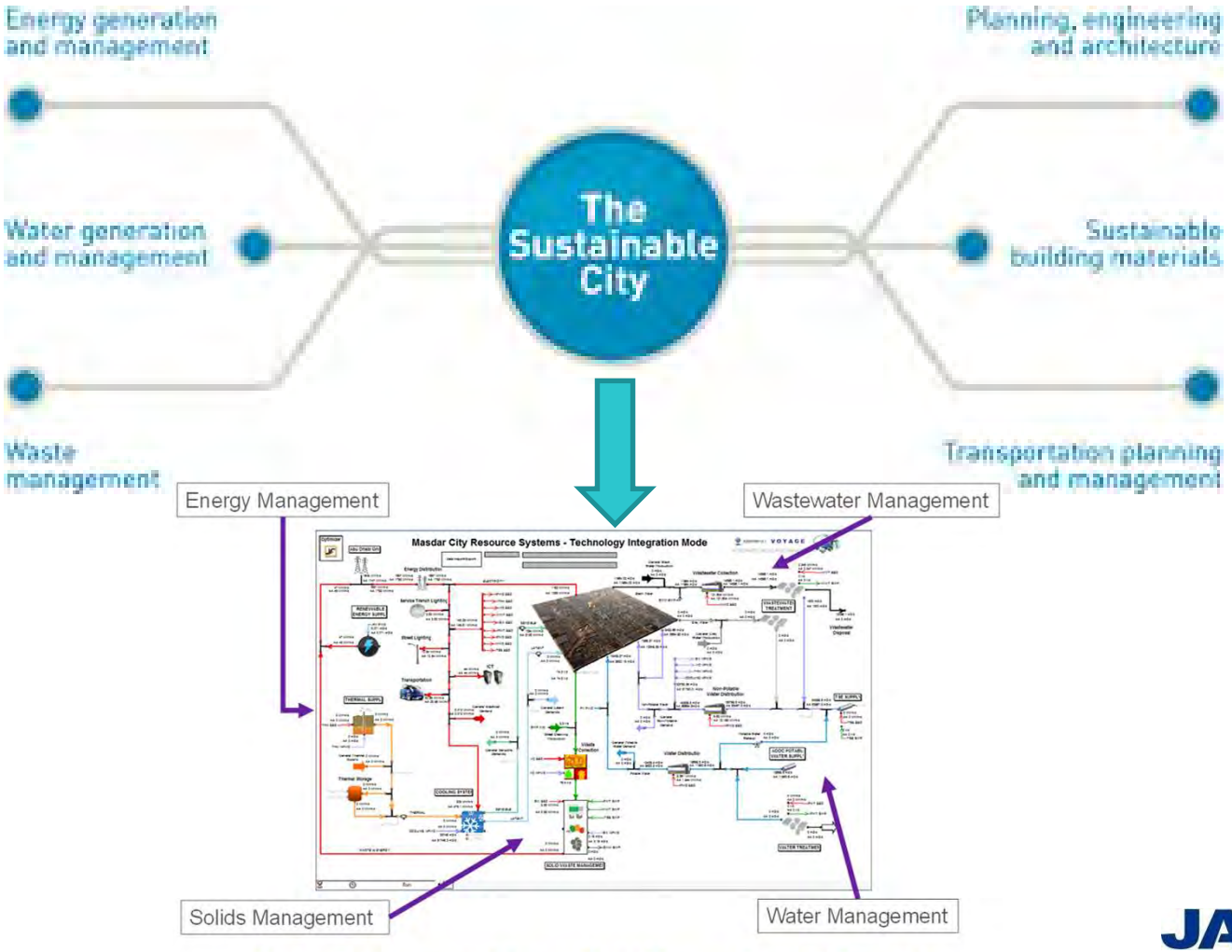

Masdar City's Integrated Voyage Model Manages Supply & Demands

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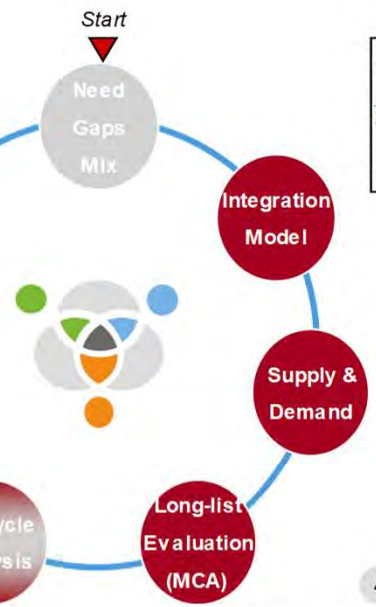
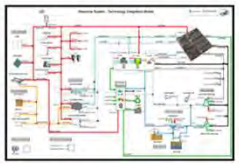
Masdar City's Technology Innovations Roadmap Process



7

- Finalise business case for CAPex
- Define KPI's for Pilot

2



- Model and validate targets (CO_2e, etc)
- Determine integration touch points

6

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

3

- Report defines the gaps
- Define possible technological solutions

5

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

4

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

Source: McKinsey, CH2M HILL, ADFEC

International Solar Panel Demonstration Site

10 MW PV Farm

City Streets Design

Natural Air Cooling Tower

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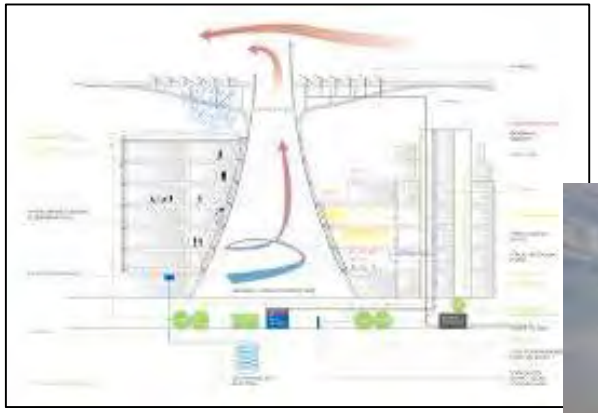

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Masdar City Roadmaps Since 2007

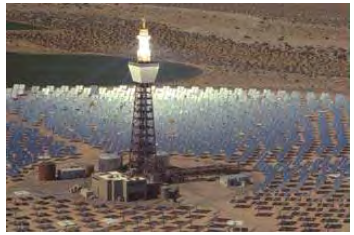
City Roadmaps Completed Since 2007:

- 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

10 MW Solar PV Farm

Green Concrete Competition

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May 1, 2019

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McKinsey & Company

How can we build megaprojects right?

SPUR

Presentation | May 2, 2019

WORKING DRAFT
Last Modified 5/1/2019 5:57 PM Pacific Standard Time
Printed 5/1/2019 5:57 PM Pacific Standard Time

Our research indicates that while poor execution is the most common culprit, market and organizational problems can lead to the most significant delays

	Description	Frequency (% of projects)	Average Overrun	Average Delay
Technical	Evaluate technical definition of all scope elements including definition of feedstock, reservoir, ore body, fluids, etc	46%	40%	51%
Execution	Review schedule, budget, major project phases, resource capacity, KPI's, health, safety, environmental practices, and logistics	**73%**	37%	53%
Market	Assess financial health, contracting strategy, financing options, pricing, and check stress scenarios	40%	**42%**	**62%**
Political	Understand status of permitting and approvals, stakeholder management, local engagement programs and land acquisition	27%	38%	46%
Organiza-tional	Assess owner capabilities, governance, inter-agency coordination, management protocols, labor strategy, and RACI	65%	**41%**	**62%**

SOURCE: McKinsey analysis of failure root causes for megaprojects across industires

Why projects go wrong: 10 most critical areas, based on our experience with over 100 mega-projects

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

SOURCE: McKinsey Capital Productivity & Infrastructure Practice

Owners systematically underappreciate the risks of megaprojects and often end up eroding value during execution

Key elements of successful value protection

Cost optimization

- Rigorous selection of design/value tradeoffs
- Analysis of project through Total Cost of Ownership (TCO) lens

Risk mitigation

- Honest, critical evaluation of risks in the project across all sources
- Cross-stakeholder engagement to anticipate and mitigate risks (e.g. public meetings to raise and address community issues)

Financing planning

- Scrutiny of business case, sources of revenue and associated risks
- Alignment of project development and financing timelines
- Clear articulation of owner's objective function (e.g., citizen benefit, commissioning of asset)

Schedule protection

- Thorough pressure-testing of pre-construction and construction timelines to ensure they are both aggressive and achievable
- Deployment of "lean" tools to reduce schedule delays and hit opening target

SOURCE: McKinsey Capital Productivity & Infrastructure Practice

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.

SOURCE: McKinsey & Company Capital Projects & Infrastructure Practice - *The Art of Project Leadership: Delivering the World's Largest Projects*

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.

SOURCE: McKinsey & Company Capital Projects & Infrastructure Practice - *The Art of Project Leadership: Delivering the World's Largest Projects*

PRACTICES – Project delivery

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.

SOURCE: McKinsey & Company Capital Projects & Infrastructure Practice - *The Art of Project Leadership: Delivering the World's Largest Projects*