Report of Expert Panel:

Downtown Rail Extension (DTX) Program Review

October 2019

Final Report

Requested by:

San Francisco County Transportation Authority

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- WSP USA
- McKinsey & Company

Table of Contents

Figures

Tables

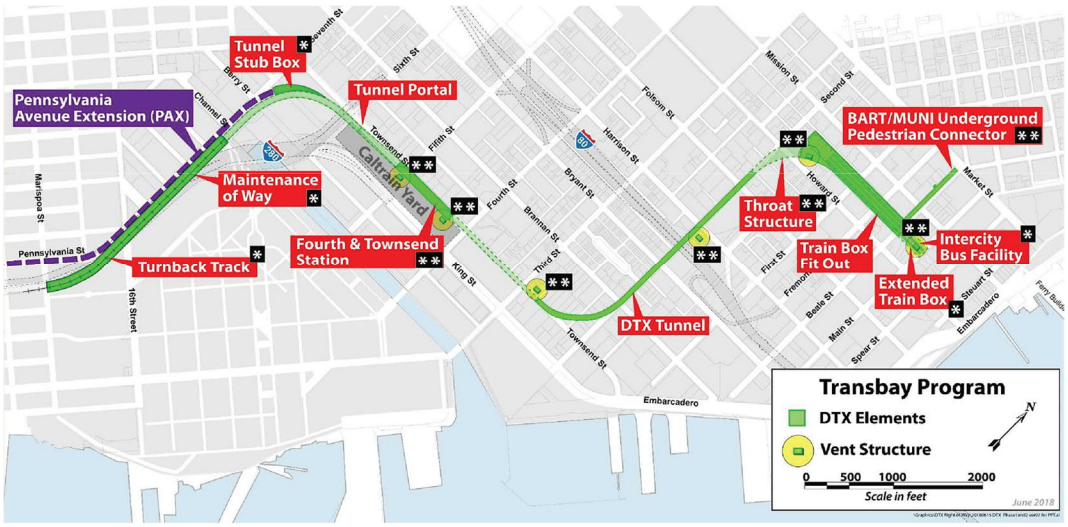
CHAPTER 1

1 EXECUTIVE SUMMARY

In April 2019, at the direction of its Board, the San Francisco County Transportation Authority (herein after referred to as "the Authority") selected an Expert Panel of 10 professionals with experience and expertise on domestic and international mega-rail projects (Expert Panel), and a supporting consultant team (Consultant Team), to review and evaluate the current and alternative governance and organizational structures, implementation plans, and funding expectations of the Downtown Rail Extension Project (DTX), currently managed by the Transbay Joint Powers Authority (TJPA).

Construction of the DTX, an approximately 2-mile underground rail tunnel and related infrastructure in downtown San Francisco (see Figure 1), is required to provide Caltrain, and the future California High-Speed Rail, access to the Salesforce Transit Center (STC) from Caltrain's 4th and King station. The project was estimated, in 2016, to cost approximately $3.9 billion (see Figure 2).

Figure 1: Proposed DTX Phase 2 Scope



This report reflects the combined efforts of this group and is hereby submitted to the commissioning Authority for its consideration and that of the other stakeholders. The Expert Panel focused on technical and policy issues and sought to be independent and objective in its approach.

Figure 2: Phase 2 2016 Cost Estimate Summary

		in $ millions
Construction	$	1,504
Design Contingency	$	211
Subtotal Construction	**$**	**1,715**
Escalation 5% to mid construction (2023)	$	583
Total Construction Cost	**$**	**2,298**
Rigth-Of-Way (ROW) Acquisition	$	298
Programwide @ 22.5%	$	517
Subtotal Construction+ROW+Program	**$**	**3,113**
Construction Contingency @ 10%	$	230
Program Reserve @ 15%	$	462
Subtotal Contingency and Reserve	**$**	**692**
Total Program Cost	**$**	**3,805**
BART/Muni Pedestrian Connector ($110M direct cost + $51M escalation & construction contingency)	$	161
Total Program Cost w/ Pedestrian Connector	**$**	**3,966**

Source: TJPA, 2016

1.1 Key Conclusions

The Expert Panel's findings and recommendations, as set forth in this report, are unanimous, building upon the consensus belief, that:

1. The DTX rail program will offer critical mobility value to the Bay Area-Gilroy-Sacramento mega-region, state and country, providing significant rail linkages to Northern California's regional rail system from San Francisco to the Silicon Valley, Central Valley, East Bay, Sacramento and eventually to Southern California.
2. The DTX stakeholders should actively and aggressively develop a plan of phased and affordable program implementation that successfully expedites the commencement of Caltrain passenger service to the STC much sooner than currently contemplated, optimally by 2028. This will require hard decisions but will be supported by a much-strengthened funding plan and more realistic expectations about short- and mid-term possibilities.
3. The project should transition from its current aspirational status to one that readies the initial phase for procurement. Stakeholders should consider undertaking a 2-Year work plan (Appendix A) which seeks to position the project optimally to commence construction by 2023. A world-class team should be assembled to manage and oversee DTX design and construction. Finally, a much-strengthened funding plan, coupled with more realistic expectations about short- to mid-term funding possibilities, must be summarized and understood by all stakeholders. The

program stakeholders will ultimately decide upon a long-term governance and management structure.

4. To achieve this transition, which the Panel believes is feasible over a two-year period, the Panel recommends specific changes to DTX's governance, management and oversight, approach to funding and program delivery. This includes setting up a multi-agency Integrated Program Team (IPT) to be co-located at MTC or the Authority's offices and appointing a new program manager with experience in urban rail megaprojects involving tunneling and rail systems integration. In addition, the Panel recommends finalizing agreements on scope, design standards and on-going operations and maintenance requirements with the rail operators: Caltrain and CHSRA.
5. This newly implemented approach to delivering DTX should place enhanced emphasis on transparency and accountability.
6. The Expert Panel strongly believes that the recommendations in this report, in conjunction with continuing to define the operating requirements related to projects such as the 4th and King Rail Yard, 22nd Street Station study and Pennsylvania Avenue alignment (PAX), will inform the operators' optimized service requirements, as well as the capital investments and phasing needed across these interrelated projects.
7. The Panel wants to underscore that the SFCTA Board made a wise decision to pause DTX funding last year, allowing the program, stakeholders, and the Authority a timely opportunity to take stock of appropriate next steps. This opportunity to re-focus will not delay the completion of a financially feasible project, but rather it is an opportunity to provide a new strategy that will place the project on a track to realistically achieve implementation.

1.2 Study Approach

1. The Expert Panel was tasked with:
   a. Reviewing current selected project documents.
   b. Reviewing best practices on governance and oversight, project delivery, risk management, and financing.
   c. Developing recommendations on changes needed to enhance the successful delivery of DTX.
2. The Consultant Team interviewed more than 20 key local stakeholders involved in the STC development and construction and the planning and development of the DTX program.
3. The Consultant Team researched and evaluated other domestic and international mega-rail and infrastructure projects to determine lessons learned (See Appendix B) and how those experiences could inform best practices on the DTX program. This information is summarized in the five case studies contained in Appendix C.

4. The Consultant Team facilitated, and the Expert Panel and stakeholders participated in, workshops and teleconference meetings to examine existing conditions and challenges facing DTX as well as evaluate alternative approaches.

The Expert Panel's findings and recommendations are summarized in: Chapter 4: Key Findings and Chapter 5: Expert Panel Recommendations.

CHAPTER 2

2 INTRODUCTION

2.1 Objectives

In seeking recommendations for advancing the DTX program, the Expert Panel was tasked to:

> Review pertinent Transbay Transit Center (subsequently named the Salesforce Transit Center [STC]) and the Downtown Rail Extension (DTX) program development documentation including engineering, environmental, right of way, program funding/financing plans and current TJPA governance and oversight structure to inform potential recommended program changes to effectively implement the DTX program.

Seeking to further inform its own decision about funding and advancing the DTX program, the Authority established the following key study objectives for the Expert Panel:

1. Review and evaluate alternative governance and oversight possibilities for the management and delivery of the DTX.
2. Evaluate and advise the Authority on DTX's current funding plan, program delivery strategies and existing organizational structure within the TJPA.
3. Advise the Authority of a recommended implementation approach for the 2016 estimated $4 billion tunnel program that could be implemented expeditiously and efficaciously.
4. Recommend a DTX rail program delivery organization to advance the DTX program.
5. Interview and engage DTX stakeholders, Appendix D contains a list of participants from the following agencies:
    a. Transbay Joint Powers Authority (TJPA)
    b. Caltrain
    c. California High-Speed Rail Authority (CHSRA)
    d. San Francisco Mayor's Office staff
    e. San Francisco Planning Department
    f. San Francisco Municipal Transportation Agency (SFMTA)
    g. Metropolitan Transportation Commission (MTC)
    h. Alameda-Contra Costa Transit District (AC Transit)
6. Research national and international mega-program case studies to identify best practices and lessons learned that might inform the Expert Panel in framing its DTX

recommendations. The programs that were selected for review included major international infrastructure programs that have experienced significant schedule and cost issues. The case studies sought to explain how the project leadership responded to address these challenges as they moved toward implementation.

The programs selected for review included:

1. Atocha-Chamartín Tunnel, Madrid
2. California High-Speed Rail, California
3. Gateway Program, New Jersey/New York
4. London Crossrail Program, London
5. San Francisco-Oakland Bay Bridge East Span Replacement, California

The case studies are presented in Appendix C of this report.

Last, the Consultant Team retained to support the Authority and the Expert Panel included WSP and McKinsey & Company. The Consultant Team developed the case studies in Appendix C in consultation with project owners.

The work of the Expert Panel progressed utilizing the methodology described in Chapter 3. Please see that chapter for greater detail on approach and methodology.

CHAPTER 3

3 METHODOLOGY

The overall study methodology included five key components:

1. Review existing program data
2. Review stakeholder interviews conducted by the consultants to understand issues and perceptions of the program, state of advocacy and buy-in and expectations for the future
3. Conduct workshops with stakeholders
4. Conduct conference calls between the Panel and TJPA staff to clarify program characteristics and status
5. Conduct Panel discussions and analysis and develop key findings, leading up to the drafting of proposed recommendations

These five components of the methodology are discussed in more detail below.

3.1 Review of Existing Data

The consultant team gathered a body of knowledge about the DTX program as it has been advanced to date by the TJPA, including detailed information on:

1. Program overview, expected benefits, and environmental documentation to date
2. Costs, risks, contingencies, current and potential funding sources
3. Design, engineering, construction, procurement and contracting methods considered
4. Operations analyses (e.g., Caltrain, CHSR)
5. Governance and oversight structure, including previous reviews (i.e., APTA Peer Review Panel, 2019)
6. 2019 CHSRA Business Plan and Caltrain Business Plan documents

A detailed list of documents is included in the Bibliography in the Reference Material section of this report. The documentation was made available to the Expert Panel for review and background for technical discussions on proposed recommendations.

3.2 Stakeholder Interviews

The consultant team conducted 22 stakeholder interviews, with TJPA management and Board members; Citizens Advisory Committee; Caltrain; Authority management and board members; CHSRA; MTC; AC Transit; the San Francisco Mayor's office; SFMTA, and SPUR (SF Urban and Regional Planning advocacy group). See list of participants in Appendix D.

3.3 Workshops with Stakeholders

Four workshops were held to hear stakeholder concerns, focusing on funding plans, management, expectations, strategic implementation, governmental/organization concepts and delivery approaches. In addition, a "Testing the Answer" workshop was held with stakeholders to review preliminary recommendations, contributions, and potential unintended consequences. Key goals and objectives for each workshop are described below.

3.3.1 | WORKSHOP 1 – DTX REVIEW KICKOFF

The DTX Review Kickoff workshop reviewed the study approach, goals and objectives, and schedule and roles. The meeting featured presentations on:

1. Transbay Program management, overview and program history, organization, oversight activities, DTX program scope, tunnel design, budget and schedule, delivery plan and the Pennsylvania Avenue Extension.
2. Caltrain Business Plan, specific long-term service goals on DTX, and end-of-line station requirements at STC.
3. CHSRA Business Plan, service, and funding commitments to STC.

3.3.2 | WORKSHOP 2 – GOVERNANCE AND OVERSIGHT

The Governance and Oversight workshop focused on current and best practices in governance and oversight – including organizational setup (i.e. board, executive management mandates, composition, operations, interactions, etc.) and major processes (i.e. risk and performance management) – and provided an opportunity for the Expert Panel to discuss implications for the DTX program.

As a result of this workshop, two follow-up conference calls were scheduled, which are discussed in more detail in Section 3.4.

3.3.3 | WORKSHOP 3 – CONTINUATION OF GOVERNANCE AND OVERSIGHT DISCUSSION; PROGRAM FINANCE AND DELIVERY WORKSHOP

This workshop provided feedback on key questions to be answered by the Expert Panel and the criteria used to shape final recommendations. The Expert Panel reviewed recommendations on program definition, program delivery, progress, governance options, funding and best practices.

3.3.4 | WORKSHOP 4 – TESTING THE ANSWER

The final workshop "tested" potential recommendations for governance and oversight, finance, and program delivery. Preliminary recommendations were presented to stakeholders to provide an opportunity for them to ask questions and share their perspectives for the Expert Panelists' consideration.

The workshop included breakout sessions where stakeholders and Expert Panel members considered preliminary criteria for determining an appropriate governing entity for the program. The Expert Panel presented 16 governance criteria to evaluate potential governance options (see Appendix E) and compared various existing or potentially new combinations of organizations that may best fit the criteria. This workshop provided an opportunity for stakeholders to join the Expert Panel in problem-solving options focused on the long-term success of DTX.

3.4 Calls with TJPA Management

Two conference calls were organized between the Expert Panel and TJPA management and top technical staff for the Panel to ask specific program development questions.

3.4.1 | FIRST CONFERENCE CALL: TJPA STAFF DISCUSSION WITH EXPERT PANEL

The first conference call, held on May 3, 2019, included a PowerPoint presentation by TJPA management addressing program definition, cost estimates and program schedule, funding, TJPA Board and executive team structure, oversight, and stakeholder management.

3.4.2 | SECOND CONFERENCE CALL: TJPA STAFF FOLLOW-UP CALL WITH EXPERT PANEL

The second conference call, held on May 10, 2019, included a review of the TJPA's proposed organizational chart for DTX, the impacts of operations analysis on program scope, the program's funding and finance plans, program delivery and schedule, rail operations reports, ridership report, and the 2019 APTA Peer Review report.

3.5 Expert Panel Discussion Sessions and Analyses, and Key Findings Development

3.5.1 | DISCUSSION SESSIONS AND ANALYSES

The Expert Panel held coordination meetings in advance of, and after, the stakeholder workshops and informal working sessions arranged to capture the full group's input. Consensus building was aided by several Expert Panel sub-groups coalesced around specific technical challenges and implications of governance proposals. The Expert Panel also applied experience from similar mega-programs.

3.5.2 | DEVELOPMENT OF KEY FINDINGS AND RECOMMENDATIONS

The Expert Panel's final stage of work was to develop key findings leading to recommendations. Findings and recommendations, presented in Chapters 4 and 5, reflect stakeholder interviews, review of existing documentation, workshop discussions, and the Expert Panel's working sessions.

CHAPTER 4

4 KEY FINDINGS

The Expert Panel's findings are presented in the following order:

1. Program Positioning
2. Program Governance and Oversight
3. Program Funding and Finance
4. Program Definition and Phasing
5. Program Development and Delivery

Case study lessons learned have been added as supporting documentation for certain recommendations. (See Appendix B.).

4.1 Program Positioning

4.1.1 | PROGRAM POSITIONING FINDINGS

1. The DTX program is at a critically important crossroad. The next steps the TJPA will take will be pivotal decisions resulting in significant expense. It is essential to get those decisions right, placing emphasis on what is financially feasible at the earliest possible date. With its re-opening, the STC will deliver an innovative, integrated strategy of transportation improvements, as well as land use, real estate development, and local and regional benefits.
2. The value proposition of the DTX program has been insufficiently clear and inconsistently messaged to the public. To date, the project has been referred to as Phase 2 of the STC and described as an extension of Caltrain's current terminus at 4th and King. This suggests that program benefits are mainly local, while not fully and clearly conveying the regional, state and national benefits of the program.
3. The Expert Panel believes the project should be more correctly seen, and consistently described, as an essential Phase 1 of a mega-regional rail development program that extends well beyond San Francisco to achieve key rail linkages in the short- to mid-term within the larger Bay Area. Longer term connections to the Central Valley, Sacramento and, ultimately Southern California will also be served by this project.
4. Current uncertainty about CHSR funding and its implementation schedule for Bay Area service adds to public skepticism, suggesting value in rethinking the current all-or-nothing approach to the project in favor of the potential benefit of a phased approach to DTX delivery, based on new, more realistic assumptions about CHSR timing and affordability limits.

5. Placing a regional priority on an earlier extension of Caltrain service into the STC establishes not only an important new regional rail connection but also strengthens and widens public support for the project as an important platform for new regional rail linkages. These include: a New Transbay Crossing, the Diridon Intermodal Station, a potential Dumbarton Bridge rail connection, the future opportunity for a one-seat ride from Sacramento to San Francisco (consistent with the 2018 State Rail Plan), and ultimately, connections to a state-wide network of intercity rail passenger services.
6. By resetting the DTX vision, the program can focus attention more clearly on the achievable and tangible benefits of faster commutes, increased productivity, housing affordability, cleaner air, greenhouse gas reductions, earthquake/climate resilience, increased mobility consistent with current and upcoming MTC's Plan Bay Area, the Caltrain Business Plan, and MTC's 2016 Core Capacity Transit Study.
7. Further clarity is required on the DTX program definition that clearly defines benefits to the Northern California mega-region. An updated business case reflecting this repositioning, and a phased approach to completing the project, will aid in reinforcing DTX as a top funding priority of ***regional and national significance*** with the supporting political consensus for critical regional, state and federal investments.

4.1.2 | CASE STUDY LESSONS LEARNED

GATEWAY PROGRAM, NEW YORK:

1. If the "value proposition" for the program is not understood by the public, reset the implementing agency and the message of why the program is necessary.
2. Restructure the agency by adding appropriate governance stakeholders and write a value proposition statement clearly articulating the benefits of the program and the consequences of not implementing the program. Rename the agency to clearly communicate the new positioning recommendations to stakeholders and the public.

   (See Appendix C for more detail.)

4.2 Governance and Oversight

4.2.1 | GOVERNANCE AND OVERSIGHT FINDINGS

1. The TJPA still has significant responsibilities in the construction closeout of the STC, managing related third-party liabilities and operating and maintaining the bus terminal and related activities.
2. The TJPA is essentially a narrowly focused, single purpose entity with only the staff and resources made available to it by its member agencies. While the development of the STC was a difficult challenge of vertical construction within a complex set of real estate and land-use parameters, the development of DTX will be exponentially

more complicated and challenging. DTX will require different areas and levels of expertise, particularly in the next phase of project planning and the follow-on phase of construction oversight and risk management.

3. The current organizational model creates bottlenecks and forces too many decisions to rise to the top level.
4. The TJPA Board can play a valuable role in overseeing a transition plan, but it would be a clear and immediate project benefit for the Authority and the Metropolitan Transportation Commission (MTC) (as key funding partners) and Caltrain (as the most immediate operator) to be more directly involved in day-to-day DTX decision-making and can carry out key transitional tasks.
5. Stakeholder interviews with funding agencies indicate a lack of confidence in the TJPA's ability to deliver DTX within estimated costs, given the substantial STC overruns to date and the potential gap between the likely cost of the DTX project, as defined, and the likely flow of construction funds, given currently assumed funding and financing plans.
6. Merely hiring more staff to supplement existing management expertise and acumen would not be sufficient to address these shortcomings. The circumstances call for fresh and more regionally represented eyes that are not wedded to the status quo and instead are committed to resetting a path more targeted to short- and mid-term success with a higher level of openness, transparency, and accountability.
7. Stakeholder management should be improved, including ensuring adequate and appropriate engagement and agreement from operators, major funders, elected officials, and other stakeholders to DTX program decisions.
8. An expansion of current oversight capabilities for a re-positioned DTX would provide greater alignment between key challenges faced by the program and key activities of overseeing agencies, particularly to reflect the concerns of the funding agencies and the rail operators.
9. Governance and oversight decisions should address long-term program management skills, roles and responsibilities (e.g., who would operate and maintain DTX) to further consider basic governance and staffing issues. Revisiting the current governance structure, with an eye to the other key findings in this report would provide a more experienced and efficient platform for program delivery and attract the support of external program champions.
10. The TJPA Board currently does not have an independent engineering advisor to provide an alternative source of technical assurance necessary for informed decision-making. The APTA Peer Review Panel recommended the addition of an independent engineering advisor to the TJPA Board in its report, "Findings of the APTA Peer Review Panel on Project Management and Oversight Provided at TJPA", published in April 2019.
11. See Appendix D for stakeholder interviews and project participants that reinforced these findings, indicating a need for:

a. Improved stakeholder management, including ensuring adequate and appropriate engagement from operators, major funders, and other stakeholders including elected officials.
b. Improved transparency in oversight-management interactions, among stakeholders, with contractors and within the TJPA staff.
c. A clarified Board mission, mandate, and decision-making focus.
d. Improved project management team composition, capacity, and capabilities.
e. Resetting new management and staff culture, particularly around transparency.
f. Improving oversight, risk, and performance management.
g. Active consideration of alternative governance options.
h. Expert exploration of alternative program delivery approaches/strategies.
i. Improved public engagement and advocacy.
j. Focus on detailed operational planning and decision-making.

4.2.2 | CASE STUDY LESSONS LEARNED

LONDON CROSSRAIL:

1. Enhanced reporting and transparency are critical to the effective management of a mega-rail program, particularly transparency in costs, schedules, and risk mitigation management.
2. Bring operation systems personnel into the governance and oversight process while design and engineering is being developed.

CALIFORNIA HIGH-SPEED RAIL:

1. Move as quickly as possible to implement strong program management requirements, oversight, and risk management protocols.

   (See Appendix C for more details.)

4.3 Program Funding and Finance

4.3.1 | PROGRAM FUNDING AND FINANCE FINDINGS

1. Given the project's outdated cost estimate, it is difficult to discern how much funding will be required to cover the capital costs of DTX. However, it is possible the cost will be greater than the revenues that TJPA projects are available for the project; particularly given the national and international experience with cost growth from this level of design with other projects of similar size and complexity.
2. The source and amount of funds the TJPA is relying on to cover the project's costs can be divided into those with higher and those with lower levels of confidence. A

significant percentage would potentially fall into the latter category, representing sources requiring votes on ballot measures not yet filed and potentially overly aspirational assumptions about other sources and amounts, notably passenger facility charges. In other words, DTX funding estimates are dependent upon highly speculative forecasts of future revenues that have not been agreed to by the funding agencies or the electorate.

3. The TJPA is currently planning to deliver the project as an all-or-nothing proposition, the resulting corollary of which is that, until 100% of project funding is completely secured, no passenger service to the STC can commence.
4. Without phasing the project to better match the amount of funding available at a higher confidence level, it is possible that the project will remain unaffordable for years to come. This will result in no rail service of any kind into the STC, absent some major unanticipated change in local, state and/or federal funding.
5. The TJPA and its project funding partners do not appear to have objectives sufficiently and adequately aligned to reconcile the potential gap between funding and project costs under current conditions.
6. The TJPA funding plan inadequately addresses the need to secure commitments, not just to cover all capital costs, but all long-term operating and maintenance costs as well.
7. There could be major unanticipated changes in local, state, and/or federal funding for which the DTX would need to qualify and compete successfully against other qualifying projects. Examples include Congressional authorizations and appropriations of funding for a new rail transit program or new local and regional sales tax measures including a potential FASTER Bay Area mega-measure.
8. The experience of other agencies using a range of delivery methods/partnerships should be explored and presented.
9. Financing strategies need to be clearly defined and evaluated, and preliminary eligibility needs to be established.
10. Because of cost increases (estimated at over 40% for Phase 1) and delays in opening, oversight agencies and potential funders appear to lack confidence in the program.
11. There needs to be a focus on developing a sound, secure, reliable, and flexible funding and financing package. Unrealistic funding assumptions need to be reevaluated considering other rail project financing challenges, i.e., passenger facility charges (PFC's).
12. The opportunity to pause and refocus on a viable funding plan now will not delay the overall delivery of the project, but rather provide a new strategy that will place the project on a realistically achievable implementation track. The establishment of a project affordability limit, supported by higher confidence fund sources, will also support this objective.

4.3.2 | CASE STUDY LESSONS LEARNED

CALIFORNIA HIGH-SPEED RAIL:

1. New mega-programs should be mindful of overly optimistic funding commitments and assumptions that may make it more difficult to deliver the program in the long run.

GATEWAY PROGRAM, NEW YORK

1. Ensure the program is ready to compete for funding when it becomes available.
2. Recognize that other mega-programs will also be in competition to receive the same funding sources.

   (See Appendix C for more details.)

4.4 Program Definition and Phasing

4.4.1 | PROGRAM DEFINITION AND PHASING FINDINGS

1. Program definition drives DTX's value proposition, deliverability, fundability, the Board's mission, required staff expertise and experience, as well as an appropriate risk management approach.
2. Redefining the program should include coordination and planning with MTC's Plan Bay Area process, BART/Capitol Corridor Joint Powers Authority's (CCJA) Transbay Rail Crossing studies, updates to CHSRA and Caltrain Business Plans and with CalSTA for updates to the State Rail Plan.
3. It is likely that TJPA's objective to build the project as currently defined, as an expensive and un-phased program, will outstrip available funding resources, now and well into the future. This could lead to a situation where the only thing TJPA will be able to afford is continued, potentially wasteful design and engineering; not provision of actual rail service to the STC.
4. The definition and roll out of the DTX program should reflect the realities of aligning concretely demonstrated needs and be vetted across schedules of prospective operators and funding.
5. The stakeholders should seek to define an initial DTX phase that would satisfy initial Caltrain requirements at a significantly lower cost than the entire project will require, potentially within the bounds of higher confidence funding levels and to complete buildout of CHSR when such access is required.
6. Defining an initial phase to provide Caltrain access within the constraints of a truly realizable funding budget may require very difficult political decisions, potentially involving the deferral of desirable, stakeholder-sought project elements that are not required to achieve service consistent with the Caltrain Business Plan and available funding.

7. Doing the hard work of successfully funding and initiating construction for an initial phase of DTX could not only achieve the important goal of connecting the STC to a regional rail network, but also help position the project to compete more effectively for supplemental and primary funding sources essential for compete build out, including the FTA New Starts Program.
8. A phased sequencing plan could match demand as it materializes, without violating the already approved environmental clearances, or impacting the cost of future expansions or precluding joint development opportunities. This sequencing plan preserves the attainment of other city planning goals and the ultimate buildout of the deferred portions of the program if, and when, supplemental funds sufficient to cover the costs are allocated.
9. To date, there has been insufficient system integration between Caltrain and CHSR on design standards (e.g., platform height, which has implications for terminal capacity and train seating capacity), and with a shared blended service plan between CHSR and Caltrain. The TJPA has not stepped in to lead a resolution of these concerns.
10. The approach should be founded in detailed operational planning studies and simulations supported and agreed to by all potential operators to achieve: a) an implementation plan that constructs (and finances) nothing before it is actually needed; and b) re-examines critical operating issues such as platform layout and heights in the light of current equipment designs and capabilities of preferred Caltrain and CHSR rolling stock.
11. While the Panel fully understands that prior studies have been undertaken to consider scoping down the project in several important respects, we urge a new and concerted effort given the realities of the project budget and changing circumstances surrounding the project.
12. All these issues influence the credibility of the program and its cost and schedule estimates, the viability of its funding plan, ability to retain public support, its likelihood of securing significant federal funding, and the organization's ability to take a leadership role in mediating and leading the processes necessary to resolve policy issues affecting the program and ultimately, to pick the most effective delivery mechanism to complete the program on time and within budget.

4.5 Program Development and Delivery

4.5.1 | PROGRAM DEVELOPMENT AND DELIVERY FINDINGS

1. The program delivery study the TJPA conducted in 2016 is currently out of date, was only qualitative in nature, was not done to current value for money best practices, and does not reflect current mega-rail project market conditions.

2. The study was not grounded in a detailed risk allocation analysis with quantified risks. Best practice is to conduct a bottom-up risk analysis first, which identifies all program risks in a comprehensive risk register, forming the basis for an analysis of optimal risk allocation across different program delivery methods and allowing, alongside other relevant strategic and regulatory factors, for the selection of the optimal program delivery method.
3. It has not been determined which operating agency or agencies will take responsibility for operations and maintenance of DTX, nor have operator concerns been resolved in the scope which will have implications for the delivery and contracting approach for the program, including whether third-party private involvement is required.
4. DTX project development is not yet founded on detailed agreements with Caltrain or CHSR on operating specifications, among other important issues.
5. TJPA staff has insufficient expertise and experience with alternative delivery of rail tunneling mega-projects, domestically and internationally; particularly in a dense urban environment. Agencies without such experience frequently have biases against those tools with which they are not familiar.
6. Traditional delivery models have proven to be less effective than well-selected alternative delivery models at controlling cost overruns, schedule delays and delivering lifecycle cost certainty and value for money.
7. Given the large size and complexity of an initial project phase, let alone undertaking the fully defined project all at once, and the unfavorable risk profile that accompanies such mega-projects, the next phase program managers should have greater experience in successful alternative delivery methodologies if DTX is to become a world-class construction and risk management program.
8. Best practices and lessons learned for mega-rail projects point to completing, before preliminary engineering is scoped, a thorough value-for-money and project delivery options analysis, to minimize engineering and design that would be redundant with some delivery models.
9. DTX project risk registers should be used to manage the program, not just comply with funding requirements. Since the program is burdened by an unfavorable risk profile, a more quantitative risk analysis is required.
10. There is a need to evaluate the experience of other agencies, including innovative procurement methods, to determine possible cost savings to the DTX program.
11. The inherent risks in the closeout of the STC need to be clearly separated from the DTX program.

4.5.2 | CASE STUDY LESSONS LEARNED

LONDON CROSSRAIL

Crossrail's management of simultaneous contracts did not account for the integration complexities of multiple rail system elements, resulting in delays and rework.

CALIFORNIA HIGH-SPEED RAIL

Carefully match construction contract scope requirements with program management capabilities. (See Appendix C for more details.)

CHAPTER 5

5 EXPERT PANEL RECOMMENDATIONS

5.1 Introduction

This section sets forth the Expert Panel's recommendations for the DTX program, based on the preceding findings and supporting analysis.

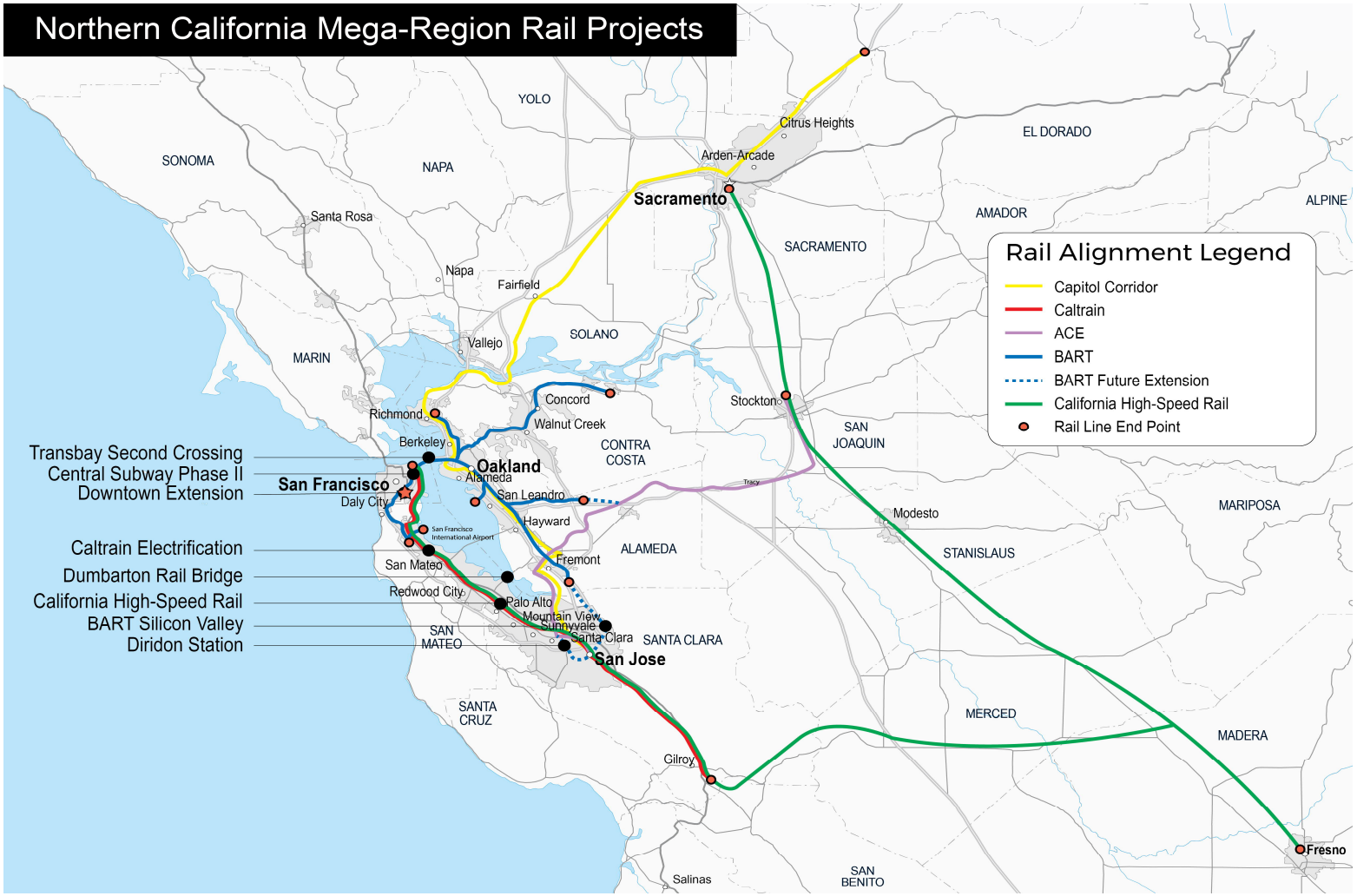
The Expert Panel's overarching recommendation is that the stakeholders should continue to actively and aggressively pursue the DTX program, albeit with specific changes to governance, management, organizational structure, funding and program delivery. The incremental transition to this new approach is outlined in the 2-Year work plan, contained in Appendix A. The consensus refinements outlined in the 2-Year work plan emphasizes transparency and accountability as the program moves forward.

5.2 Program Positioning

5.2.1 | PROGRAM POSITIONING RECOMMENDATIONS

1. More clearly articulate the DTX program's value proposition as a:
    a. **Critical link for the mega-region's transit and passenger rail systems**, delivering essential mobility and interconnectivity with existing systems, including Caltrain, BART and Muni, while establishing the connectivity platform for future systems, such as CHSR, a new Transbay Rail Crossing, the Diridon Intermodal Station, and potentially a new Dumbarton Bridge rail service. (See Figure 3: Northern California Mega-Region Rail Projects map)
    b. **Develop foundational priority program benefits** for both mega-regional economic development and addressing larger regional policy goals, such as affordable housing, social equity (especially in access to employment centers), urban design/walkability, public health, and other community benefits.

Figure 3: Northern California Mega-Region Rail Projects



Source: WSP

2. **Reposition the DTX program** so that it is no longer improperly viewed as benefitting mainly the City and County of San Francisco, but is clearly separated (e.g., in legal, public perception and regional benefit terms) from what to date has been referred to as Phase 2 (STC). Instead, the program must be understood to be an independent program of regional and national significance that will:
    a. **Secure the long-term, durable support of key local, state, and federal elected officials, stakeholders and the broader public** over the DTX program lifecycle.
    b. **Build on the program's regional priority** within MTC's Plan Bay Area through regional planning efforts, e.g. Plan Bay Area updates, Caltrain and CHSRA Business Plan updates, CalSTA's updates to the State Rail Plan and BART/CCJPA's Transbay Rail Crossing study.
    c. **Strengthen the DTX program's claim on existing revenues** (e.g., New MTC/Bay Area Toll Authority [BATA] Bridge toll funds, RM3; Mello-Roos and Tax Increment Residual after Transportation Infrastructure Finance and Innovation Act [TIFIA] repayment) and potentially emerging revenues (e.g., congestion pricing, new national infrastructure funds, a new regional sales tax measure [FASTER Bay Area], and potential private financing funds).
3. **Rename the DTX program to reflect its new positioning** (e.g., California Regional Rail Connector or Northern California Rail Mobility Hub) and use policy positioning successfully employed for analogous programs of regional and national significance to align with federal funding programs. (e.g., LA Metro's Regional Connector Subway Program).
4. With a new value proposition, **the DTX program should arm its Board, program team, and key stakeholders with clear talking points and a communication strategy** to garner renewed support and public awareness of the benefits of the DTX program.
5. **Prepare a DTX business** case where project benefits can be quantified and measured relative to costs and objectives for changes to the rail system metrics (e.g., service upgrades, travel time savings, greenhouse gas reductions, incremental phasing, etc.) should also be measured and included in the value proposition/business case for the DTX program.
6. **Reposition DTX as a "Project of National and Regional Significance" to align with federal funding programs.** This will increase the potential for FTA funding for the project by demonstrating regional prioritization with a commitment to delivering an initial phase of Caltrain service with state and local funding.

5.3 Governance and Oversight

5.3.1 | GOVERNANCE AND OVERSIGHT RECOMMENDATIONS

1. **Refocus the core responsibilities of the TJPA**, as currently constituted or in a refined form, on:
   a. Closing out the STC design and construction contracts.
   b. **Resolving potential third-party liabilities** associated with construction of Phase I.
   c. Operating and maintaining the terminal and related facilities.
2. Subject to direction on policy and legal issues, stakeholders should **enter into a memorandum of understanding (MOU)** between the **TJPA, Caltrain, CHSR, MTC, CCSF, and the Authority** pursuant to which:
   a. Day-to-day responsibility and staffing of the **DTX program and program-level decision-making authority would be transferred to an Integrated Program Team** (IPT).
   b. The transfer would become effective as soon as practicable, but **no later than the end of calendar year 2019.**
   c. The IPT would be comprised of staff seconded from or recruited by the Authority, MTC, TJPA, CCSF, CHSR and Caltrain and would **possess proven leadership, organizational acumen, and relevant experience in delivering the kinds of tasks included in the transitional 2-Year work plan**, with other support as needed.
   d. The IPT would be housed within MTC or the Authority. IPT **responsibilities would be subject to an organizational matrix specifying what approvals the IPT would need for different levels of decisions and reporting** up to the TJPA Board. The agencies would be responsible for determining which approval procedures would work best. Among the possible options:
      i. An IPT Program Director, with proven leadership, organizational acumen, and relevant experience in delivering all aspects of mega-rail projects.
      ii. An Executive Steering Committee (ESC) comprised of the Executive Directors of each member agency with the ability to appoint a technical advisory committee (TAC), or group of deputy directors, to advance decisions and provide oversight of project funding and delivery activities.
      iii. For this new organizational structure to be successful, the TJPA Board would agree that action on any DTX program matter would be subject to prior approval of executive representatives of the TJPA, Authority, MTC, CCSF, Caltrain and CHSR.
      iv. The ESC would report to the TJPA Board, who would be responsible for final approvals, pending inter-agency MOUs.

3. **Charge the IPT with carrying out a 2-Year work plan**. The Panel has attached a 2-Year work plan (Appendix A) for stakeholders to consider which would reposition the program and advance procurement (if the delivery model is to be Design-Build, Design-Build Maintain or Design-Build-Finance–Maintain) or final design (if Design-Bid-Build).

   Among key tasks included in the work plan are the following:

   a. **Development of realistic funding assumptions** and securing of initial phase capital and O&M revenues sufficient for the initial phase.

   b. **Resolution of design criteria, capacity requirements, access and schedule commitments for Caltrain and CHSR**, should take into consideration the optimal governance for, and management of, the DTX program from the completion of the 2-Year work plan to the point of revenue service for the initial phase.

   c. **Phase the implementation of the DTX project to deliver rail service to the STC within clearly established stakeholder delivery date expectations,** backed by an affordability limit and high confidence funding plan.

4. Following the activities outlined in the 2-Year work plan, **the IPT should consider options for the optimal successor agency.** The Panel recommends considering a regional rail development and construction authority or a single-purpose construction authority, analogous to the Exposition Line and Foothill Gold Line construction authorities that LA Metro formed to develop a generation of light rail facilities in LA County, as discussed in the Caltrain Business Plan.

5.4 Program Funding and Finance

5.4.1 | PROGRAM FUNDING AND FINANCE RECOMMENDATIONS

1. **Separate high confidence level revenues from low confidence level revenues**, more realistically assessing the timing by which revenues will be received and/or advanced, with carefully laid out assumptions.
2. **Establish a credible plan** (with stakeholder assistance) for securing the amount and timing of capital funding necessary to deliver an initial phase of the DTX program to a high level of confidence, within an **affordability limit and by a date certain.**
3. **Establish affordability levels for each program phase** where strategic program definition and phasing are premised on realistic funding and cash flow assumptions.
4. **Leverage the experience of other local agencies** using a range of delivery methods/partners, etc., to determine **possible cost savings** to the DTX program.
5. Provide **clear direction to the state's Congressional delegation on the DTX program benefits**, in all requested federal funding and financing grant applications.

6. Reach **agreements with Caltrain and CHSR to cover the costs of operating and maintaining** the DTX rail program and/or identify sources of funding sufficient to cover such costs.
7. Consider establishing a **formal mechanism for periodic review of potential funding sources as policies and priorities evolve** at the local, regional and federal level (including both government funding and private sector interests).
8. Solicit input from the private sector (via informal processes or via public solicitations) to **incorporate the latest innovations in service delivery for a best practice outcome** and to continue building public confidence in the project's delivery.

5.5 Program Definition and Phasing

5.5.1 | PROGRAM DEFINITION AND PHASING RECOMMENDATIONS

The newly defined DTX program would seek to identify the following:

1. **An Initial Operating Phase** that will achieve Caltrain rail service to the STC by a date certain (perhaps 2028) set by stakeholders, and within a budget supported by higher confidence level revenues. The initial phase should:
    a. **Maintain consistency** with California Environmental Quality Act/National Environmental Policy Act (CEQA/NEPA) project envelope.
    b. **Retain eligibility** for FTA and other federal discretionary funding and financing, and strengthen the DTX program's competitive position regionally and nationally.
    c. **Reflect agreements between Caltrain and CHSR** on the DTX program design and operational requirements, rights, responsibilities; clarification on the operations and maintenance of the new track and rail portion of the DTX program and be documented through binding MOUs and updates to both Caltrain's and CHSRA's Business Plans.
    d. **Include the future efficient build-out of eventual CHSR service** and the components needed to support a new Transbay Rail Crossing or potential joint development opportunities. These program elements should be actively examined in achieving the most cost-effective Initial Operating Phase.
2. The Initial Operating Phase would be defined with an affordability limit consistent with higher-confidence program funding sources.
3. Stakeholders would be required to make difficult decisions to defer selected project elements, in a way that is permitted by NEPA/CEQA.
4. Prepare a **risk assessment of the timing of CHSR construction to support a staged rail implementation program** and conduct a value for money options or cost/benefit analysis to evaluate any deferred CHRS project elements.

5. **Initiate a planning process** to better understand program impacts from other regional rail projects and forecasted growth of those systems (e.g., Second Crossing, Caltrain and CHSR).
6. Carry out a **project delivery options value for money analysis** to compare alternative delivery approaches.
7. Undertake **value engineering** to study tunneling options.
8. Develop a risk adjusted cost estimate.
9. **Scope preliminary engineering** for the initial phase to align specifically with the selected project delivery method.
10. A combined **systems capacity study and operating analyses** should be conducted across Caltrain/CHSR as soon as possible. The output of this work should define anticipated capacity, realistic timing for expected capacity and train throughput, necessary design criteria to clarify scope, and inform funding planning and program delivery approach.
11. Operator involvement across the design, testing, and commissioning phases is required for both the Downtown Extension and the Pennsylvania Avenue Alignment (PAX), when applicable, to ensure successful transition from construction/delivery to eventual operability.
12. An appropriate level of granularity is critical. For example, the Expert Panel suggests **clarifying the decision requirements needed for selecting platform height(s)**, including evaluating the impact of choosing a uniform versus dual heights for Caltrain and CHSR (e.g., platform heights may have a significant impact on train seating capacities and operating flexibility), the impact of common versus dual platform heights on operating capacity and reliability, trade-offs on space used for retail vs. for rail operations and customers should be addressed.
13. The stakeholders should seek to define an initial DTX phase that would satisfy minimum Caltrain requirements at a significantly lower cost than the entire project will require, within the bounds of higher confidence funding levels and ensure an efficient buildout of CHSR when such access is required.
14. Prepare a follow on phased implementation approach that will complete the DTX rail program as currently and functionally contemplated.
    a. This next phase should be sufficiently flexible to respond to the timetable for Caltrain service growth, the start of CHSR service, the new Transbay Crossing and other regional improvements as noted in Figure 3.
    b. Establish an affordability limit for this phase within the constraints of a high confidence level funding plan.
    c. Defer project elements not absolutely required to establish initial phase service to the extent their costs do not exceed the affordability limit.

   d. Include studies of potential impacts of other regional rail projects, a CHSR schedule risk assessment, project delivery value for money analyses, value engineering on tunnel construction options, and a risk-adjusted cost estimate.

15. **Evaluate and summarize alternative program infrastructure options** that could support the most appropriate DTX project scope and cost.

5.6 Program Development and Delivery

5.6.1 | PROGRAM DEVELOPMENT AND DELIVERY RECOMMENDATIONS

After defining the Initial Operating Phase and subsequent phases of the DTX program, and before further preliminary engineering, the IPT for the DTX program should:

1. **Perform a robust, quantitative delivery options analysis,** considering Design-Bid-Build (DBB), Design-Build (DB), Design-Build-Maintain (DBM) and Design-Build-Finance-Maintain (DBFM) to determine which delivery method or combination of methods yield the highest "value for money" and strongly considers operational planning and potential private-sector financial involvement.
2. **Identify within the Initial Operating Phase the key cost and schedule drivers, risks, opportunities** for performance and/or outcome-based specs, public sector and private sector innovation; and, continually evaluate and ensure transparency in cost estimating and program delivery schedules.
3. **Scope preliminary engineering for the initial phase** to align with the selected program delivery method(s).
4. **Maintain on-going relationships**, communication, problem-solving, and decision-making with program operators.
5. **Revisit and update broader public communications and engagement strategies** by providing an unprecedented level of transparency to stakeholders and the public.
6. **Develop and host a structured, best practices market-sounding program** that would capture direct, market-leading input on a variety of important topics, including phasing, tunneling, optimal program delivery and finance options, areas to preserve for private-sector innovation and performance specifications.
7. **Solicit input from the private sector** to incorporate innovations for best practice outcomes.
8. Prior to commencing preliminary engineering as currently defined, **undertake a comprehensive quantitative and qualitative project delivery options analysis**, consistent with value for money best practices, and reflecting a thorough market-sounding process and industry outreach program.

9. **Select the preferred project delivery option and scope all subsequent design and engineering**, upon completion of such analyses and outreach, consistently to avoid over-design and waste of engineering services.
10. **Ensure that project management has no bias in favor of or against any method of project delivery**, whether traditional or alternative, and ensure decisions reflect in-depth experience with other agencies' mega-rail project construction (both domestically and internationally). This in-depth experience should focus on tools that are most likely to minimize cost growth, schedule creep, and maximize quality outcomes and lifecycle cost efficiencies.
11. **Prepare the project for best practice construction oversight and risk management**, including foundational and regularly updated quantitative risk analysis and risk registers, not just to comply with funding requirements but to ensure effective project management throughout the project lifecycle.

APPENDICES

Appendix A: 2-Year Work Plan

2-Year Work Plan to get a re-envisioned Rail Program back on schedule, establish the final institutional arrangement with a clear mandate and capability to implement it, and select a project delivery method

	#	Task	Sub-task Description	2019		2020				2021	
				Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
	Decision: path forward informed by expert panel recommendations			◆							
(0) Establish IPT, Transition Plans, and Stakeholder Engagement	**0.1**	**Establish Integrated Project Team (IPT), develop transition plans, and stakeholder engagement to re-position the Rail Program**	(a) Workshop(s) with stakeholders to establish IPT governance and staffing, develop transition plans and multi-party MOU, incl. seamless shared agreement for the Rail Program								
			(b) Allocate and define roles and responsibilities for all Work Plan tasks, incl. allocation of tasks to be led by IPT vs. tasks to be coordinated with other agencies								
			(c) Organize seconded and/or recruited staff for the IPT capable of carrying out the 2-year work plan, including identification of program manager and other support								
			(d) Secure stakeholder commitments for steering committee and conduct stakeholder mapping across level of support and importance to success								
			(e) Develop clear statement of objectives as Project of Regional and National Significance with regional priority, and clear objectives and tracking system for stakeholder engagement								
	Decision: adopt plans and agreements for transitional governance, IPT staffing and organization, and stakeholder engagement plan				◆						
	0.2	**Ongoing management and stakeholder engagement**	(a) Execute and implement transition plan and agreements								
			(b) Ongoing oversight and management in the transition phase								
			(c) Maintain clear records of stakeholder engagement								
			(d) Manage key initiatives to address issues								
			(e) Track accountability of all stakeholder engagement processes								
(1) Re-definition of Fundable & Deliverable Program	**1.1**	**Identify the full list of STC users, direct and indirect, and relevant plans**	Caltrain and CHSR based on their current/updated Business Plans; transit users; and, New Transbay Crossing based on 2018 State Rail Plan, regional rail plan, and current BART/CCJPA planning study								
	1.2	**Prepare re-definition plan to establish an initial operating phase at the earliest possible date and address other program components including PAX, Rail Yards, 22nd Street Station, and the STC through-station concept to support Transbay Rail/BART**	(a) Planning, operational, and engineering studies to achieve project re-definition and initial operating phase, incl. planning and environmental permitting requirements								
			(b) Conduct PAX pre-environmental/environmental and coordinate w/ Rail Yards development planning (per MOU) and 22nd Street Station study led by SF Planning								
			(c) Perform demand vs capacity scenario analysis over time and side-by-side comparison of options in terms of benefits (economic, riders, housing, etc.), costs, schedules, operations, etc.								
			(d) Develop detailed cost estimates, schedules, and extensive risk register and analysis based on structured workshops, incl. risk management program and independent reviews								
			(e) Develop plans for utility relocations and ROW requirements, including risk management and insurance plans, early works packages, and third party agreements as needed								
			(f) Resolve critical operational issues for all users of the initial operating phase, conduct operational analysis, and coordinate operators' plans and requirements								
	1.3	**Develop and confirm Funding Plan strategy for the Rail Program based on realistic funding assumptions and securing of capital and O&M revenues sufficient for the initial phase**	(a) Develop funding plan for construction and operations, incl. definition of affordability limit, inter-agency responsibilities, securing commitments, schedule of availability, and tasks to enter FTA funding process								
			(b) Conduct assessment of high/ low confidence sources of funding with focus on funding initial operating phase and funding strategy of subsequent phases								
			(c) Develop new/innovative funding and financing sources including joint development (e.g., Rail Yards) enabled by Project Re-Definition strategy								
			(d) Develop funding plan for operations phase, incl. funding agreements and commitments to support initial operating phase operating costs								

	#	Task	Sub-task Description	2019		2020				2021	
				Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
	1.4	**Prepare a preferred Phasing Plan conforming with evolving policy direction on realistic amounts/timing of funding and stakeholder delivery date expectations - with an explicit goal to deliver rail service to the STC at the earliest possible date**	(a) Prepare Rail Program phasing options in response to rail service scenarios, funding sources and availability, and stakeholder requirements								
			(b) Develop detailed work plan for ongoing tasks (engineering, planning, permits, etc.)								
			(c) Develop detailed risk management and assurance plans including ownership, staffing, independent strategic advisor / independent engineer, and management processes								
	Decision: select project definition, phasing plan, and funding plan strategy										
	1.5	**Ongoing development of technical and funding studies to support Tasks 1 and 3**	Funding plan development, engineering analysis and design, cost estimates, scheduling, risk analysis and risk management, operational analysis, planning of future phases, permitting, early works to support initial operating phase, etc.								
(2) Governance and Oversight Review and Transition	2.1	**Define responsibility for final institutional arrangement and preferred structure for optimal governance for and management of the Rail Program from completion of the workplan to at least the point of revenue service for the initial phase.**	(a) Detailed study to identify the governance structure to enable stakeholder alignment, effective mega-project delivery, oversight, independent strategic advice, and assurance. Give strong consideration to options such as single purpose construction authority (e.g., those used by LA Metro), Regional rail development and construction management approach (e.g., discussed in organizational assessment of Caltrain's latest business plan), or others. Stress-test options to maximize opportunities for Federal funding as a Project of Regional and National Significance.								
			(b) Develop management structure, briefs with roles and responsibilities, staffing qualifications, reporting and communication protocols, contracting, and staffing plan								
			(c) Conduct assessment with Strategic, Economic, Commercial, Financial, Management cases and considering responsibilities for O&M of new trackage and the rail portion of STC								
			(d) Develop outcomes-based performance and sourcing management system, regime of Key Performance Indicators (KPIs), and stage-gated decision making protocols								
	Decision: confirm and adopt final institutional arrangement for project delivery, organization, agreements, and staffing										
	2.2	**Transition to final institutional arrangement and organization**	Preparation for carrying out the Program beyond the 2-Year work plan or transferring subsequent responsibilities to a successor entity and management team. Execution and implementation of Task 2.1 outcomes in coordination with the selected project delivery method from Task 3.2.								
(3) Project Delivery Option	3.1	**Qualitative delivery options analysis**	Conduct market sounding through an RFI and other tools with infrastructure industry and update the qualitative delivery options analysis previously completed.								
	3.2	**Quantitative delivery options analysis**	(a) Conduct workshops to allocate risk based on risk analysis from Tasks 1.2 and 1.5, and develop analysis and plans for insurance								
			(b) Conduct project delivery options analysis based on a business case and risk-adjusted financial analysis, including input from the market sounding in Task 3.1								
			(c) Analyze legal framework and issues for delivery options, procurement, and development of contracts								
			(d) Develop a strategic implementation roadmap including a procurement and contracting plan, risk management plan, and organizational requirements								
			(e) Scope pre-procurement engineering and early works contracts tailored to the delivery options								
	Decision: select delivery option for the Rail Program's initial operating phase										
(4) Procurement		**Start procurement tasks as applicable based on selected project delivery method and scoping**	The following to be led by the final institutional arrangement team based on the selected phasing plan and project delivery method for the initial operating phase: For-construction plans and engineering, costing, scheduling, performance specifications, funding, outreach, procurement documents including RFQ/RFP, ongoing planning of later phases, etc.								

Appendix B: Best Practices Lessons Learned Matrix

The following lessons learned are derived from the case studies summarized in Appendix C.

LESSONS LEARNED	ATOCHA CHAMARTÍN TUNNEL	SAN FRANCISCO-OAKLAND BAY BRIDGE EAST SPAN REPLACEMENT	CALIFORNIA HIGH-SPEED RAIL	CROSSRAIL	GATEWAY PROGRAM
Governance/Decision-Making/Program Management	• One single Spanish agency (ADIF) has controlled this program throughout its development and implementation. • Program delays in opening the tunnel were explained to the public as consequences of the 2007-2008 global financial crisis; additional information related to the management of this delay is still being sought.	• Involving multiple agencies with program oversight responsibility for a mega-program ensures more unified oversight and representation of all stakeholder interests. • Co-locating Caltrans, MTC and BATA staff ensured all stakeholder needs were present for program management and implementation requirements. • Governance structure is based on circumstances and the best information available at the time. It will and should evolve as the program moves through different phases. • The program structure should reflect the needs of the program rather than operate within the confines of the existing organizational structure.	• Move as quickly as possible to implement strong program management requirements, oversight and risk management. • New mega-programs should be mindful of overly optimistic funding promises and assumptions that will make it more difficult to deliver in the long run. • In general, using cost ranges, both for costs and funding forecasts, proves more appropriate for long term program delivery. • Having most ROW acquired, negotiation of third party agreements and final alignment decisions in hand prior to moving into construction has been CHSRA 's commitment to the CA Legislature now into the future.	• Risk identification and mitigation must be raised to the executive level when they are known. • Decision-makers should have experience in the work of the current phase of the program. Many of the individuals responsible for the successful early phases of the program's completed construction did not have a background in operations or systems integration at this crucial phase of implementation. • Enhanced reporting and transparency are critical to the effective management of a mega- rail program, particularly transparency in costs, schedules and risk mitigation management.	• Considerations for governance should include: » Federal grant and loan eligibility » Ownership » Program delivery capacity » Maintenance and operations responsibility » Liability » Enabled powers and abilities of member organizations » Political resiliency » Timely and effective program delivery • If the "value proposition" for the program is not understood by the public, reset the agency and the message. • Rename the agency and write a "value proposition" for the program clearly articulating the value of the program and the consequences of not doing the program.

LESSONS LEARNED	ATOCHA CHAMARTÍN TUNNEL	SAN FRANCISCO-OAKLAND BAY BRIDGE EAST SPAN REPLACEMENT	CALIFORNIA HIGH-SPEED RAIL	CROSSRAIL	GATEWAY PROGRAM
Finance	• National and European funds were jointly used on this program to advance convenient cross border rail operations.	• The delays to redesign the bridge had major implications for costs and schedule.	• The CHSR was questioned throughout the state and Washington DC following the release of the 2018 Business Plan. However, the next Business Plan, due in 2020, will have a sound foundation to build on as the program moves forward to identify additional funding to extend the Central Valley segment to complete Phase 1.	• These situations need to be addressed in risk registers and risk mitigation plans at all phases of implementation; not just in the testing and commissioning phases of a rail program. • Responsible agencies and program sponsors moved quickly to identify funding sources to maintain momentum of the Crossrail program.	• Ensure the program is ready to get in the queue for funding when it becomes available. » Recognize that other mega-programs will also be in competition to receive the same funding sources. • A program of this size needs to rely on funding commitments and agreements between partner agencies to help advance the program. • An economic analysis (and benefit cost analysis) of a mega-program can aid the case for funding and is a critical part of key decision-making.
Program Delivery Approach	• Design Build within ADIF	• Selecting a program delivery approach for each individual contract (rather than all contracts) would have enabled greater flexibility for the overall program.	• Design Build contract management is challenged absent full ROW acquisitions, all third-party agreements, etc. • Match construction contract scope requirements with program management capabilities.	• Bring operation systems personnel into the decision-making process as early as possible while design and engineering is being developed. • Crossrail's management of simultaneous contracts did not account for the integration complexities of multiple rail system elements. Resulting in delays and rework.	• Federal involvement is critical for both the political resiliency of a program and funding commitment.

LESSONS LEARNED	ATOCHA CHAMARTÍN TUNNEL	SAN FRANCISCO-OAKLAND BAY BRIDGE EAST SPAN REPLACEMENT	CALIFORNIA HIGH-SPEED RAIL	CROSSRAIL	GATEWAY PROGRAM
Key Challenges and Resolution Mechanisms	• Maintain momentum when funding challenges are presented by advancing other critical components of the program; i.e. station upgrades. • Consider linking the tunnel program to station upgrades to present one successful package to the public, rather than separate programs.	• A program management approach that takes the size, complexity, and cost of a mega-program into account is critical for ensuring that the program is delivered on schedule and within budget. • Having legislation that mandates oversight and risk management should be a requirement for every mega-program to ensure the appropriate controls are in place to deliver it successfully.	• Mega-rail programs require a rigorous and structured internal and external oversight procedures. The early procedures that were in place at the outset of the program tended to reflect a “Caltrans” approach to reporting and oversight. • The existing risk management and oversight structure within CHSRA is a major improvement over earlier years of the program.	• Oversight and integration of construction contract work ongoing simultaneously with design work for stations can significantly increase program risks. • Implementation of new rail systems requires larger lead times for testing and commissioning.	• Reconstitute an organization if the correct stakeholders are not initially involved in an integrated team.
Risk Management	• TBD	• A robust risk management approach needs to be implemented at the start of the program. • Identifying the types of processes that needed to be in place to deliver the program in advance would have provided a more structured approach for dealing with program issues.	• Risk management issues must be understood at the top levels of leadership and transparently shared with the public.	• Risk reports must be viewed and understood at the highest management levels. • Complex mega-programs with integration requirements of multiple systems must be analyzed carefully with a full understanding and forecast of the potential risks and the mitigation measure costs.	• TBD

Appendix C: Case Studies

ATOCHA CHAMARTIN TUNNEL, MADRID

PROGRAM OVERVIEW

Program Description

The Atocha Chamartín Tunnel will connect Madrid's two high-speed rail (HSR) stations (Atocha and Chamartín) when it is operational. The tunnel is 7.3 kilometers (4.5 miles) long and has double tracks, along with electrical systems. It was constructed with a tunnel boring machine in nine months, for an average depth of 45 meters (148 feet). The tunnel passes under eight metro lines, as well as two existing standard gauge tunnels.

Construction has been completed, with testing and commissioning currently ongoing. The first phase of rail operations is anticipated to commence in early 2020.

Currently, trains serving Valladolid leave from the Chamartín Station and trains going to Barcelona-Seville and Barcelona-Malaga use high-speed bypass tracks around Madrid to avoid having to turn trains at the Atocha Station. The tunnel will allow rail service to northern Spanish cities to travel non-stop, or with a stop through Madrid and onward to southern and eastern cities and vice versa. In other words, the tunnel allows for the through routing of HSR trains from the southern and eastern half of Spain with the HSR rail lines in the north. ADIF and RENFE are planning to put the tunnel into service for through trains coming from the south and east to the north and west, stopping in Chamartín. Trains will not be able to stop in Atocha Station until the new underground station is finished.

In researching the Atocha-Chamartin tunnel program, certain information was not available due to funding and engineering issues that halted the project at the stations, following the initial construction of the tunnel. Station work and testing is ongoing but information on the history and current program data was difficult to obtain during the timing of this case study and report resulting in "TBDs" under certain categories.

Figure 4: High-Speed Rail Connections in Spain

Source: MJSmit, Wikimedia Commons

The tunnel program also includes the addition of safety equipment and automatic train control upgrades.

Figure 5: Inside the Atocha Chamartin Tunnel

Source: ADIF

ADIF, the Spanish state-owned railway infrastructure manager, under the direction of the Ministry of Development, is also moving ahead with major renovations of both the Atocha and Chamartín stations. Although these station upgrades are not part of the tunnel program itself they are critical to adding additional capacity to serve forecasted HSR ridership. These improvements will significantly increase capacity for current and programed HSR passengers. For the Chamartín Station, an additional 10 platforms will be constructed, bringing the total number to 31. Based on the demand for more HSR service in northern Spain, 18 platforms will be dedicated to HSR (as compared with the six when the station was originally constructed) and 13 platforms will be used by commuter, regional and other wider-gauge trains. Estimated costs of the Chamartín Station improvements are €322 million.

At the historic Atocha Station, upgrades include construction of two 420-meter-long platforms served by four tracks to the Chamartín Station, located underground on the western side of the station. A new concourse and renovation of the rest of the existing station will increase the capacity from its current 22 million passengers in 2017 to a programed capacity of 40 million passengers per year (see Figure 6). The upgrades at the Atocha Station are currently estimated at €432 million. The entire station upgrades are estimated for completion in 2025.

Figure 6: Visualizations of Improvements at Atocha Station

Source: ADIF

Responsible Agency

ADIF, the Spanish state-owned railway infrastructure manager, is the agency responsible for constructing the tunnel and connecting tracks and station modifications at Atocha and Chamartín. It is the legal successor to Spain's original HSR infrastructure agency, RENFE.

Estimated Program Costs and Completion Dates

Work on the design and engineering of the tunnel was initiated in 2004; however, work was halted in 2007-2008 due to the global economic crisis. Work was completed on the tunnel boring phase of the program in 2011 and electronic systems were installed in 2017-18. Throughout these delays, tunnel program costs have ranged from €206 million to a current cost estimate of €322 million.

Audit information was requested for documentation of the costs of these delays, but no audits on this program were available to date.

GOVERNANCE/DECISION-MAKING/PROGRAM MANAGEMENT

Program Organization and Evolution

Governance and decision-making have always rested with ADIF. It is a Spanish-owned public company reporting to the Ministry of Development.

Ultimately, ADIF is controlled by the Spanish Congress under the Ministry of Development. Construction programs sponsored by ADIF are controlled by a Construction Manager. Reporting to the Construction Manager is the:

1. Civil Manager
2. System Manager
3. Power Supply Manager

ADIF also has Line Directors who lead oversight for rail lines under its control. Reporting to the Line Director is the:

1. Chief Engineer of Systems
2. Chief Engineer of Civil Work
3. Chief Engineer of Power Supply

Key Decision-Making Mechanisms and Responsibilities

TBD

Program Management and Oversight Approach

TBD

Lessons Learned

TBD

FINANCE

Program Finance Mechanisms and Sources

This program is being funded by the Spanish Ministry of Public Works and Transport with secured funding through the European Bank (EIB). The track extensions of the Atocha-Torrejon de Velasco section received European subsidies amounting to €141.1 million from 2007–2013. In addition, between 2014-2020, the Connecting Europe Facility (CEF) is co-financing track assembly and facilities with a subsidy of €9.5 million.

A current complete list of the entire tunnel and station upgrade funding sources was not available.

Challenges with Securing Funding

As noted earlier, the tunnel program was delayed due to the economic crisis during 2007–2008. However, the crisis also resulted in diminished travel demand so the program delay did not cause capacity issues up until now.

It is important to note that the tunnel civil works were finished with the funding prior to the crisis and the delay only affected electrification and signaling, which may have resulted in price increases, but those price increases were only a small fraction of the total cost of the tunnel.

In researching this program, there does not appear to be major public concerns with the delay, despite the increase in costs. As the tunnel, will serve the expanded station capacities at Atocha and Chamartín stations, and those upgrades are ongoing, it appears the program will be advanced when many of those station upgrades are in place.

Lessons Learned

TBD

PROGRAM DELIVERY APPROACH

Program Delivery Approach

ADIF halted the tunnel program in 2011 following the tunnel boring work and the completion of the tunnel lining due to a lack of funds. ADIF is currently moving forward on the major renovations at the Atocha and Chamartín stations. In our research on this case study, and in interviews with Sener USA contacts, there does not appear to be a major public outcry on the delay of the tunnel's opening. Although WSP and Sener requested audits for the program, none have been conducted to date.

The delay in the tunnel's opening was also affected by the completion of two programs:

1. The new double track section between Atocha and Torrejón de Velasco to increase the capacity (from 2 to 4 tracks) in the section approaching capacity (currently all HSR trains from the South and East use only two tracks in the final section, about 20 miles) and to allow trains from the South (Sevilla and Malaga) and East (Valencia, Alicante and Murcia) lines to use the HSR tunnel. The current configuration of tracks in Atocha HSR Terminal would not allow these trains to use the tunnel, rendering the tunnel useless.
2. The connection of the tracks from the HSR line to Barcelona to the tunnel. This program is currently in design phase.

KEY CHALLENGES AND RESOLUTION MECHANISMS

Lessons Learned

Faced with a real economic crisis in 2007-2008, the Atocha-Chamartín Tunnel was forced into a delay due to funding. However, in the absence of full funding for the tunnel, progress was made on planning and designing the two stations. This phased implementation may have allowed a more efficient and effective delivery approach that ultimately would minimize reconstruction requirements. To maintain momentum in times of funding shortfalls, consider linking station upgrades to the tunnel program to present one successful program to the public.

Mega-programs should never lose sight of the end goal—even if there are challenges along the way, phases of the program can accommodate interim demand and budget availability.

Urban infrastructure and rail connections follow transportation demand and must be planned appropriately to meet this demand.

RISK MANAGEMENT

Risk Management Approach

ADIF maintains a strong risk management approach, per our interviews. However, no specific reports or information was available in our research.

CONCLUSION

Although this tunnel program has been delayed, ADIF took advantage of the time to advance the "book end" stations of the new tunnel. The delay resulted in inflationary increases in the budget for the tunnel, but it is unclear at this point if those increases may have been made up in a more informed design for the Atocha and Chamartín Stations. Hopefully, a summary audit and delivery report in the future will address these lessons learned for other mega-rail programs.

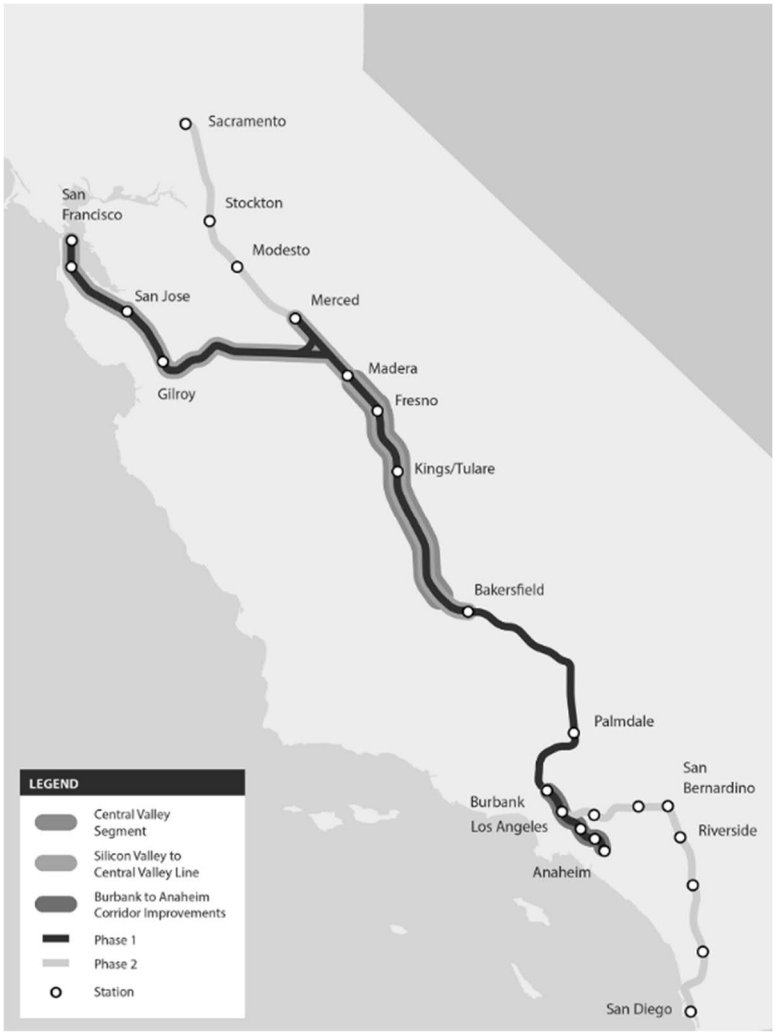
CALIFORNIA HIGH-SPEED RAIL, CALIFORNIA

PROGRAM OVERVIEW

Program Description

The California High-Speed Rail (CHSR) program is the first high-speed rail corridor program to be undertaken within the United States, linking San Francisco to Los Angeles in Phase 1, with extensions to Sacramento and San Diego in Phase 2. (See Figure 7 below.) The California High-Speed Rail Authority (CHSRA) was created by state legislation in 1996 to plan, design, build, and operate a high-speed rail system in California and the state's voters approved moving forward with development of the system in 2008.

Figure 7: California High-Speed Rail Program Statewide Map



Source: California High-Speed Rail Authority, 2018 Business Plan

The measure passed with 52.6% of the statewide vote. Chapter 2704.09 in the Prop 1A ballot measure included that the "the high-speed train system to be constructed pursuant to this chapter shall be designed to achieve the following characteristics:

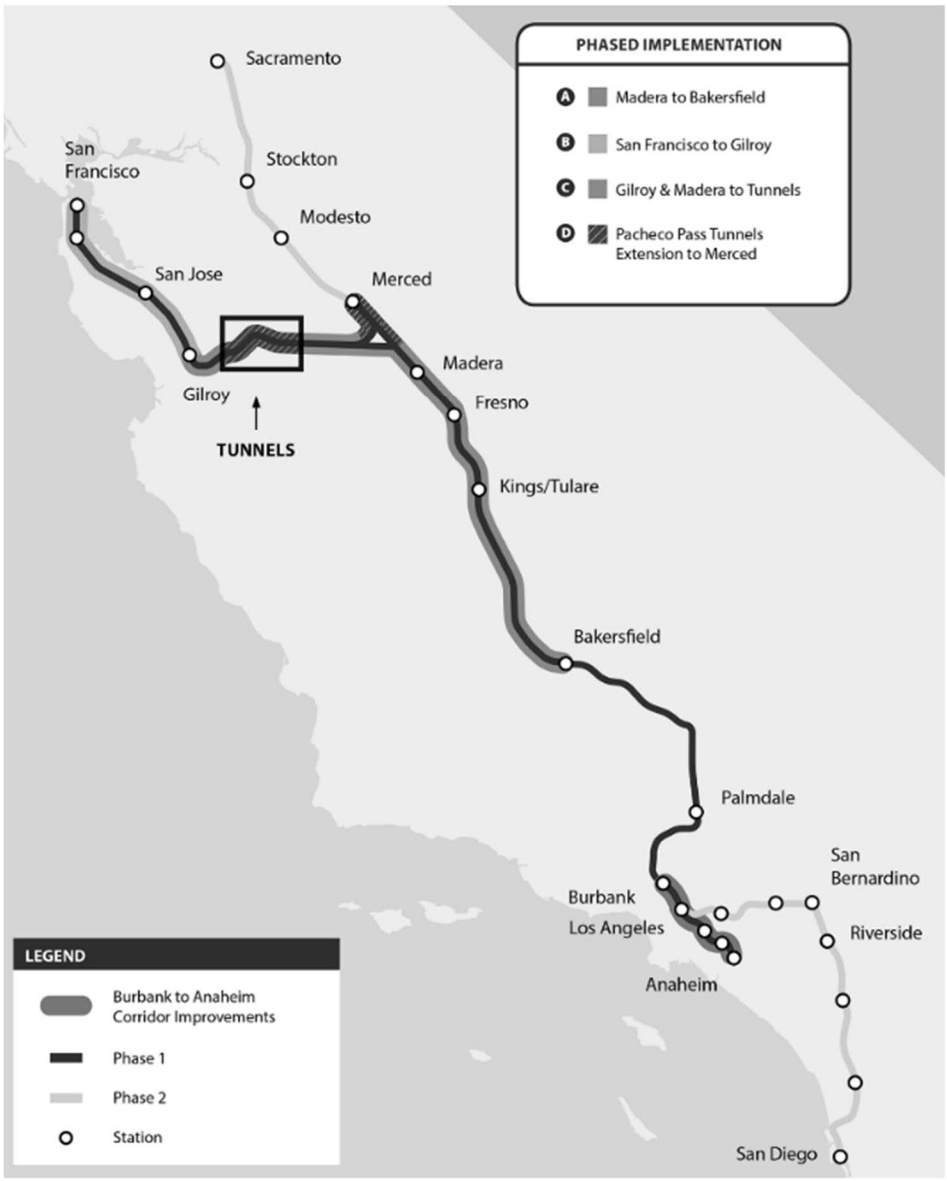
1. Electric trains that are capable of sustained maximum revenue operating speeds of no less than 200 miles per hour.
2. Maximum nonstop service travel times for each corridor that shall not exceed the following:
    a. San Francisco-Los Angeles Union Station: two hours, 40 minutes.
    b. Oakland-Los Angeles Union Station: two hours, 40 minutes.
    c. San Francisco-San Jose: 30 minutes.
    d. San Jose-Los Angeles: two hours, 10 minutes.
    e. San Diego-Los Angeles: one hour, 20 minutes.
    f. Inland Empire-Los Angeles: 30 minutes.
    g. Sacramento-Los Angeles: two hours, 20 minutes.
3. Achievable operating headway (time between successive trains) shall be five minutes or less.
4. The total number of stations to be served by high-speed trains for all the corridors described in subdivision (b) of Section 2704.04 shall not exceed 24. There shall be no station between the Gilroy station and the Merced station.
5. Trains shall have the capability to transition intermediate stations, or to bypass those stations, at mainline operating speed.
6. For each corridor described in subdivision (b), passengers shall have the capability of traveling from any station on that corridor to any other station on that corridor without being required to change trains.
7. To reduce impacts on communities and the environment, the alignment for the high-speed train system shall follow existing transportation or utility corridors to the extent feasible and shall be financially viable, as determined by CHSRA.
8. Stations shall be in areas with good access to local mass transit or other modes of transportation.
9. The high-speed train system shall be planned and constructed in a manner that minimizes urban sprawl and impacts on the natural environment.
10. Preserving wildlife corridors and mitigating impacts to wildlife movement, where feasible as determined by the authority, to limit the extent to which the system may present an additional barrier to wildlife's natural movement."

In May 2007, the CHSRA defined the two program phases:

1. Phase 1 of the rail system includes 520 miles linking San Francisco via the Transbay Transit Center (later named Sales Force Transit Center) to Los Angeles and Anaheim.

2. Phase 2 of the system, approximately 280 miles, would extend the system to Sacramento in the north and San Diego in the south. (see Figure 8.)

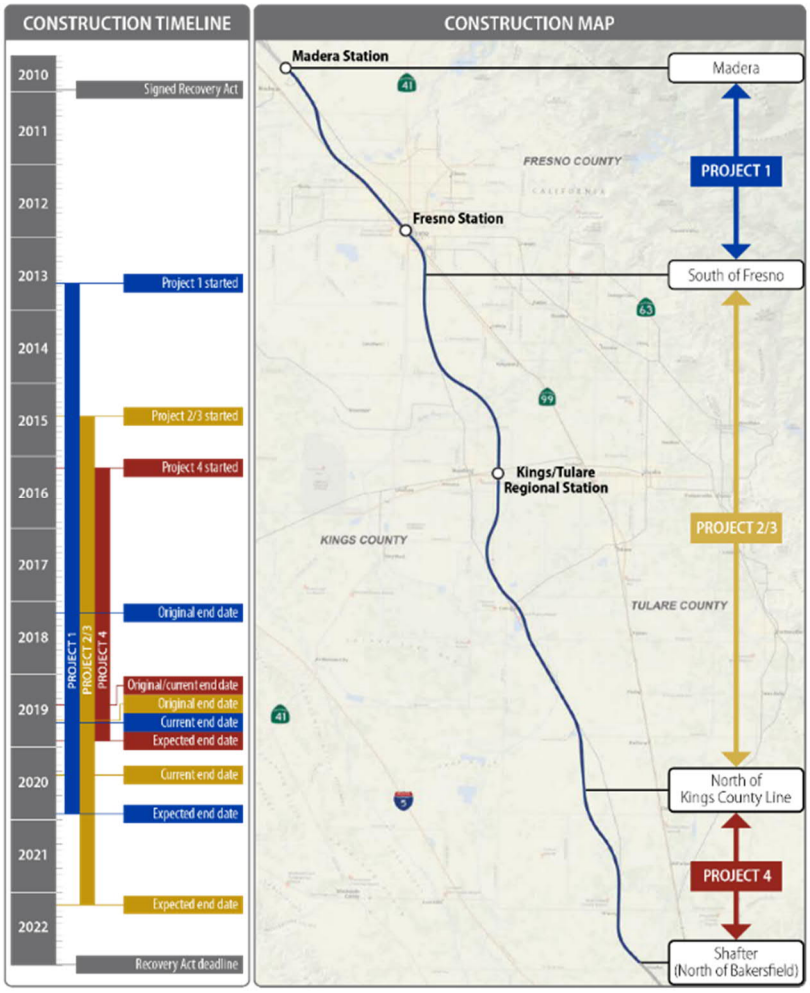
Figure 8: Silicon Valley to Central Valley Segment of CHSR System



Source: California High-Speed Rail Authority, 2018 Business Plan

Currently, the CHSR program is in construction in the Central Valley with Contract Package/Program 1 (between Madera and South of Fresno), Contract Package/Program 2-3 (South of Fresno to North of Kings County Line) and Contract Package/Program 4 to Shafter. (See Figure 9.)

Figure 9: Central Valley Contract Package/Program 1 and Contract Package/Program 2-3, Contract Package/Program 4



Source: California State Auditor, Report 2018-108

The benefits of the California High-Speed Rail Program extend beyond the objective of providing residents with convenient and fast rail service linking the state's major employment centers. In CHSRA's 2018 Sustainability Report, a full list of those benefits is summarized within the context of a "Sustainability Framework," shown in that report's Exhibit 1 (shown as Figure 10 on the following page):

Figure 10: Summary of CHSR Program Benefits

PRIORITY	OBJECTIVES
Energy 	▸ Reinforce a clean energy economy through the use of on-site renewable energy systems at stations ▸ Strengthen public health by improving air quality ▸ Maximize the consumption of renewable fuels to the extent feasible ▸ Promote long-term price stability ▸ Reduce Vehicle Miles Traveled (VMT)
Natural Resources 	▸ Maximize reductions in greenhouse gas (GHG) emissions ▸ Improve air quality ▸ Conserve, maintain, and restore habitat and wildlife corridors through landscape scale mitigation ▸ Conserve agricultural land ▸ Restore and maintain ecosystem health ▸ Reduce the demand for virgin natural resources through the use of recycled materials
Sustainable Infrastructure 	▸ Design, construct, and operate infrastructure in conformance with Authority principles for sustainable infrastructure ▸ Design, construct, and operate facilities that cost-effectively achieve State of California and local energy and sustainability policies ▸ Design, construct, and operate resilient systems and facilities that can adapt to changing climate conditions ▸ Protect employee and customer health during construction and operations
Station Communities, Ridership & Community Benefits 	▸ Provide convenient station access to all high-speed rail station areas ▸ Design and construct stations and infrastructure that reinforce Sustainable Community Strategies (Senate Bill 375) ▸ Promote livable development patterns through community partnerships ▸ Reinforce quality of life through design of the built environment ▸ Promote active transportation (e.g., walking and bicycling) ▸ Promote local and regional transit connectivity to high-speed rail stations
Business & Management 	▸ Improve the economic value to Californians through increased access and mobility ▸ Achieve a self-sustaining financial structure ▸ Achieve continual improvement of delivery and management ▸ Operate and maintain the system transparently and accountably ▸ Maximize opportunity for private investment ▸ Incorporate adaptation considerations into investment decisions

Source: California High-Speed Rail Authority, Sustainability Report

Responsible Agency

The California High-Speed Rail Authority (CHSRA) is responsible for implementing the state's high-speed rail program. The program is staffed by approximately 250 state employees with offices in Sacramento, San Jose and Los Angeles. CHSRA is supported by various consulting contracts ranging from legal and accounting services, right of way (ROW) services, rail operations planning, construction management and program management services, to name a few. (WSP is currently under contract to the CHSRA to provide program management services under the Rail Delivery Partnership contract.)

Estimated Program Costs and Completion Dates

1. The CHSR system total construction estimates have been revised over time. For example, in 2008, program costs were estimated at $40 billion. At the time the 2018 CHSRA Business Plan was released, total program costs were revised to a range of $63 billion to $98.1 billion. Current plans from the 2018 Business Plan includes the following:
    a. Phase 1 cost of $77 billion.
2. Plan to initiate service in stages, starting with the three construction contracts in the Central Valley, covering 171 miles from Merced to Bakersfield at a cost of $208 billion that can be completed by 2018.
3. Further extensions will be dependent on the availability of future funding but include a priority to connect the Silicon Valley with the Central Valley and then from the Central Valley to Southern California.

GOVERNANCE/DECISION-MAKING/PROGRAM MANAGEMENT

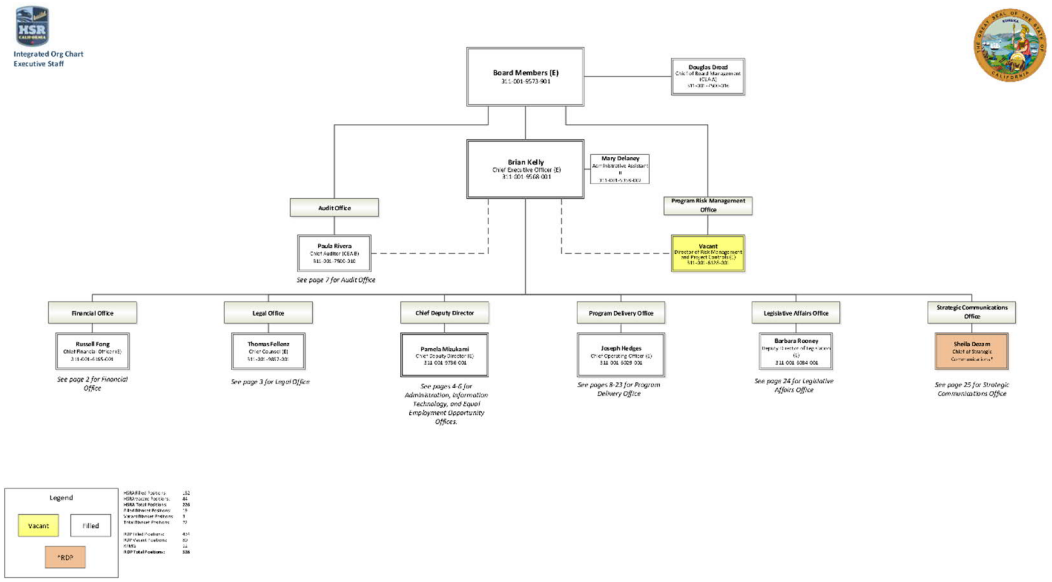
Program Organization and Evolution

The CHSRA was established in 1996 by Senate Bill 1420, the High-Speed Rail Act. SB1420 created the CHSRA as a state agency. It also tasked the CHSRA to direct the development and implementation of intercity high-speed rail service that would be fully coordinated with other public transportation services. The CHSRA was required to prepare a plan for the construction and operation of a high-speed train network for the state and to submit that plan to the California Legislature, the Governor, and ultimately, to the state's voters. The bill also prescribed various powers to the CHSRA, including planning, construction contracting, financing, and operations of a high-speed rail system.

Following the passage of Proposition 1A in 2008, which authorized $9.95 billion in general obligation bonds and the award of federal American Recovery and Reinvestment Act (ARRA) funds and federal FY2010 funds in 2009 and 2010, the CHSRA worked to define the program further, obtain state and federal environmental clearances, and move toward the award of initial construction contracts in 2013 and 2014.

Key Decision-Making Mechanisms and Responsibilities

Figure 11: California High-Speed Rail Authority Executive Organizational Chart



Source: California High-Speed Rail Authority

The CHSR program is directed by a Board of Directors. The CHSRA Board has five members appointed by the Governor, two by each house of the Legislature (for a total of nine voting members) and two ex-officio non-voting members who are members of each house of the Legislature (one each).

The CHSRA is also a department under the California State Transportation Agency (CalSTA) which oversees the program directly. As noted in the CHSRA's Program Management Plan (2018), the Board is responsible for developing CHSRA policies as put forth in the CHSRA's Business Plans and Strategic Plans, providing general managerial oversight of the CHSRA and overseeing the CHSRA's planning, construction, finance and operations.

The Chief Executive Officer (CEO) is hired by the Board and is the accountable senior executive for the execution of the CHSRA's program. Staff reporting to the CEO include:

1. The Chief Deputy Director, who is responsible for the CHSRA's administrative operations supporting the agency's broader mission;
2. The Chief Operating Officer, responsible for the execution of all aspects of the CHSRA's delivery operations;
3. The Chief Financial Officer, responsible for advising all offices of the CHSRA on financial matters and the management of the Financial Office;
4. The Chief Counsel, who advises all executive management, the CEO and Board on legal matters;

5. The Chief of Strategic Communications, responsible for advice to the CEO, the Board and all executive management on communications related issues;
6. The Deputy Chief Operating Officer, who directs the Rail Delivery Partners, providing technical expertise and managerial oversight; and
7. The Deputy Director of Legislation, responsible for administering the CHSRA's federal and state legislative programs.

Program Management and Oversight Approach

In response to both internal and external audits over the last several years, the CHSRA has implemented extensive program management and oversight processes and procedures. These include:

1. Monthly confidence meetings covering scope, schedule and budget issues for the three regions within the state, including senior and executive staff reports.
2. Refinement of the CHSRA's Program Management Plan (October 2018) documenting ongoing oversight efforts and regularly scheduled meetings that include:
    a. The Executive Committee, which meets weekly, or at the direction of the CEO, to resolve issues raised by the Business Oversight Committee (BOC), the Program Delivery Committee and the Administrative Committee, as well as issues the CEO raises for consideration.
3. The Business Oversight Committee (BOC), which meets monthly to review and examine the financial and operations changes to the program's baseline and cash flow forecasts; assess and approve all significant changes in program scope, timeline and budge; evaluate program risks; authorize contract mediations/amendments or significant acquisitions; and to ensure the appropriate use of public funds.
4. The Program Delivery Committee (PDC), which meets monthly to provide governance and oversight of programmatic execution and performance. This includes overseeing environmental, capital, and support development and delivery, monitoring the appropriate and performance of program controls, evaluating risk impacts to the program's baseline and summarizing trends for review by the Executive Committee.

Lessons Learned

It should be noted that the development of a program delivery organization, processes and governance in advance of issuing a Notice to Proceed on large Central Valley construction contracts was not an option available for the CHSR program, as it generally is in other programs.

However, the implementation structured oversight program now, with emphasis on program manager input and strong executive leadership, review and approval, has

introduced a disciplined environment for CHSR decisions on costs, schedule and budget as the program moves forward.

This approach is reflected in the 2018 Business Plan which now accurately summarizes cost and schedule/ It also lists potential challenges the program faces, which the executive leadership and Board are committed to resolving.

Finance

The May 2019 SB1029 Program Update Report, provided to the California State Legislature, notes that approximately 1/3 of the of the total funding required for the CHSR system has been secured. Those funds include:

1. $2.5 billion through the ARRA funding in 2009 (see Figure 12)
2. $920 million in 2010 from federal Transportation, Housing and Urban Development funding
3. $650 million in one-time Cap- and- Trade funding in 2014, along with a Senate Bill 862 which allocates 25% of annual Cap-and -Trade funds to the CHSRA
4. An additional $5 - $7.5 billion in Cap-and-Trade funding was committed to the CHSRA in 2017 when the Legislature extended the program through 2030.

Figure 12: CHSR Program Funding Sources

Funding Source	Total Authorized Funding A	Total Appropriated / Received	Total Expended to Date B	Total Remaining C = A - B
Federal Funds				
ARRA Construction	$2.06	$2.06	$2.06	-
ARRA Planning	$0.49	$0.49	$0.49	-
FY10	$0.93	$0.93	-	$0.93
State Funds				
Proposition 1A Planning	$0.68	$0.58	$0.43	$0.25
Proposition 1A Central Valley Segment Construction	$2.61	$2.61	$1.44	$1.17
Future Proposition 1A for Silicon Valley to Central Valley Line Construction	$4.17	-	-	$4.17
Proposition 1A Bookends	$1.10	$1.10	-	$1.10
Cap-and-Trade Received through December 2018	$2.42	$2.42	$0.61	$1.81
Subtotal	$14.45	$10.18	$5.02	$9.43
Future Cap-and-Trade*	$6.00 – 9.00	$6.00 – 9.00	-	$6.00 - $9.00
Total	**$20.45 – 23.45**	**$16.18 – 19.18**	**$5.02**	**$15.43 – 18.43**

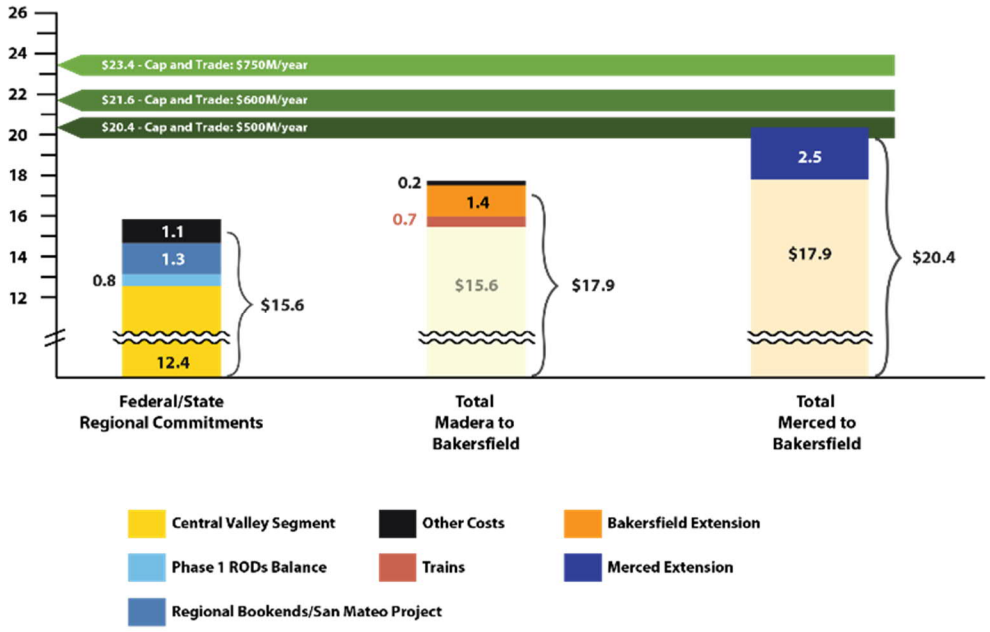
Source: California High-Speed Rail Authority, 2019 Program Update Report to the California State Legislature

As noted in the SB1029 Program Update Report:

> "Based on current cost estimates and funding projections, there is sufficient funding to complete the federal ARRA grant scope-construction of the program between Poplar Avenue and Madera, including track, and to complete the environmental reviews for the Phase 1 system."

As noted in Exhibit 3.1 in the 2019 Program Update report, shown as Figure 13, the CHSRA is also programing that completing the Merced-Fresno-Bakersfield line is "also within their funding capacity" based on current cost estimates and funding assumptions.

Figure 13: Funding Sources Compared to Program Cost Estimates ($YOE in Billions)



Source: California High-Speed Rail Authority, 2019 Program Update Report to the California State Legislature

Challenges with Securing Funding

Funding challenges to the program remain. Since the passage of Prop 1A, the program has never had sufficient funding to complete the entire 800-mile system. Prop 1A only provided approximately 1/5 of total costs and, further, required that those funds be matched by a 1:1 ratio by other funding sources that were not identified at the time. In addition, it is possible that based on recent letters from the federal government, $929 million in FY2010 might be jeopardized, an action that the CHSRA and the State of California are contesting now.

Other funding risks noted in the 2019 Program Update Report include:

1. No funds committed to the program beyond 2030
2. Prop 1A funding totally $4.2 billion has yet to be appropriated
3. Cap-and-Trade may prove to be more volatile than programed, which would have an impact on long-term planning and construction contract awards.

Lessons Learned

New mega-rail programs should be mindful of overly optimistic funding promises and assumptions that make the program more difficult to deliver in the long run.

In general, using ranges, both for costs and funding forecasts, proves more appropriate for long term program delivery.

PROGRAM DELIVERY APPROACH

The CHSRA has broad procurement authority, not typical for most California State agencies. To date, the CHSRA has used a design-build approach for the Central Valley construction contracts and competitive bidding for non-construction contracts.

KEY CHALLENGES

Risk Management

The CHSRA has maintained a robust Risk Management Report to executive leadership and the Board throughout the program. This effort has been substantially upgraded with the implementation of the vigorous and structured oversight procedures the agency has implemented in recent years.

Identify Audits

The High-Speed Rail program has been closely scrutinized and oversight requirements reviewed from the beginning of program development. These have included the CHSRA's internal auditors and the Bureau of State Audits. Further oversight has included the federal General Accounting Office, the California Legislative Analyst Office, various peer review groups, the Federal Railroad Administration and others.

As early as 2010, California legislative audits were produced for the program. At least 12 are documented on the California Auditors Office website. Although many of these audits documented compliance with various funding sources, it was noted in a 2010 audit that program management capabilities of the new state agency, as it was poised to embark on large and complex construction contracts, should be a major focus for the CHSRA's Board and executive leadership.

The most recent California State Audit Report 2018-19 received extensive attention in the press, but also sought to address how cost and schedule delays had evolved and how resolution mechanisms could be implemented.

Major recommendations of the audit included the following:

1. The CHSRA's decision to begin construction before completing proper planning led to cost overruns and delays.
2. As change orders are approved, the CHSRA should rely on the guidance and estimates of contracted oversight firms.
3. Before executing future construction contracts, the CHSRA should "specify specific benchmarks related to land acquisition, utility agreements and external stakeholder agreements."
4. The CHSRA should provide quarterly updates to the Legislature outlining progress on the three Central Valley construction contracts.
5. If the CHSRA does not anticipate meeting the December 2022 federal grant deadline, a contingency plan should be developed by May 2019.
6. Prioritize contract management skills in hiring and reviewing the performance of the Authority's contract managers. (By May 2019)
7. The established internal Contract Management Support Unit, should regularly monitor contract manager compliance and oversight and be composed solely by state staff, as opposed to consultant services. (By May 2019)
8. Contract manager supervisors should require and review evidence form contract managers demonstrating their approval of deliverables, performance and amendments for merit, as opposed to consultant services. (By May 2019)
9. Develop procedures for evaluating whether new or existing administrative duties should be developed by consultants versus state employees. (By May 2019)
10. Develop formal methodologies for assessing the adequacy of oversight firms review and approval of construction contracts. (By May 2019)
11. Develop formal process for tracking out of scope work of oversight firms. (By May 2019)
12. Improve the effectiveness of the Authority's Sustainability Policy. (By May 2019)
13. Evaluate the sustainability impacts of the HSR's construction and document compliance with existing quality controls. (By May 2019)
14. The CHSRA should compare the three construction programs' performance to contractors' original bassline estimates. (By May 2019)
15. Identify and track measures to compare construction impacts across the CHSR construction contracts. (November 2019)
16. Expand quarterly SME, DBVW and DBE utilization reporting and identify why exemptions were identified for selected contracts. (May 2019)

The CHSRA concurred in each of these audit recommendations. Detailed responses are noted in Brian Kelly's October 22, 2018, letter the CHSRA provided the Auditor's office and included at the end of this case study.

Identify Changes/Outcomes Resulting from Each Audit

As noted above, the CHSRA concurred in each 2018 audit finding. The detailed responses, regarding the actions that were and are being implemented are also contained in Brian Kelly's letter. They included:

Resolution Mechanisms 2018 Audit

See above actions that have been taken by the CHSRA.

Lessons Learned

Mega-program organizational structures, program management and oversight processes need to be in place prior to the initiation of complex construction contracts. CHSR was required to develop these institutional requirements after major contracts were in place in the Central Valley following a decision to advance the program as quickly as possible. As demonstrated in other case studies, it is critical to the contractual scopes of work with the program's capabilities to manage them at the time the contract is implemented. Leadership of mega-programs, board and executive staff must convey the risks involved in this approach to the public, as well as explaining the advantages of moving fast to obtain significant revenues.

RISK MANAGEMENT

Risk Management Approach

As noted in previous sections, the CHSRA has substantially overhauled the program's risk management procedures. Costs and schedules are now consistently and accurately reported and any changes to existing construction contracts, change orders, etc., must be justified by the program manager and her/his direct reports. The program's risk management analysis continues to rely on Monte Carlo analyses, among others.

Lessons Learned

The Authority's Board and executive leadership made a calculated decision to accept ARRA funding in 2009–2010 and proceeded to advance the program as quickly as possible. Although this decision advanced the program, it has also had an impact on rework costs and left the agency open to audit and oversight criticisms.

Although the CHSRA has moved quickly to accept and address oversight recommendations, other new mega-programs considering early construction work to acquire construction funding should understand the unintended consequences and risks of this approach.

CONCLUSION

The implementation of a structured oversight program, with emphasis on program manager input and strong executive leadership, has introduced a disciplined

environment for CHSR decisions on costs, schedule and budget as the program moves forward. This approach is reflected in the 2018 Program Management Plan and Business Plan which were developed in response to the challenges the program faces, and which the executive leadership and Board are committed to resolving.

CALIFORNIA HIGH-SPEED RAIL AUTHORITY LETTER TO STATE AUDITOR

CALIFORNIA
High-Speed Rail Authority

October 22, 2018

Brian Annis, Secretary
California State Transportation Agency
915 Capitol Mall, Suite 350-B
Sacramento, CA 95814

Dear Secretary Annis:

The California High-Speed Rail Authority (Authority) appreciates the opportunity to respond to the California State Auditor (CSA) draft audit report issued on October 15, 2018. The CSA conducted this audit at the request of the Joint Legislative Audit Committee. The audit's scope addressed the efficiency and efficacy of the policies and practices employed by the Authority. We concur with and will work to implement the CSA's recommendations as an integral part of the Authority's commitment to excellence and continuous improvement. We are pleased to report that we have begun implementing these and other corrective actions to remedy the issues identified.

The Authority is making progress on delivering the California high-speed rail system. The Authority's challenge has been to evolve its organization and improve its program management processes, while concurrently delivering this complex mega-program. We are working to meet this challenge through a continuous improvement process by which we methodically and regularly identify and apply lessons learned. Through this ongoing process, we are taking systematic steps to expedite the Authority's transition to a more rigorous program management and delivery organization. This evolution included establishing new governance structures in mid-2017 -- that we further strengthened in 2018 -- to more effectively manage the program through highly structured configuration management and change processes.

To advance and expedite this organizational transition, the Board of Directors recruited new leadership in 2017. The Board appointed me as the Authority's Chief Executive Officer and my tenure began in February 2018. I was joined immediately thereafter by two newly appointed senior executives I selected to support me in leading this organization – a new Chief Operating Officer and a Chief Deputy Director. Those individuals brought specific skill sets in construction and program delivery and in administrative management. Together, we and the rest of the senior executive team take the audit's recommendations seriously.

My senior executive team has reviewed the audit and is working with staff to address the CSA's recommendations. This will include conducting root cause analyses and implementing additional corrective actions beyond the audit's recommendations, if necessary. We regard this as an opportunity to further solidify the systemic improvements that the Authority has continued to establish and that we have strengthened over the last year.

Also, the CSA's audit coincides with the Authority's development of three key foundational governance documents that are essential to our ongoing process of continuous improvement.

First, in May 2018, the Board of Directors adopted the 2018 Business Plan, which lays out the Authority's implementation strategy for delivering California high-speed rail. Second, in June, the Board adopted our 2018 Program Baseline, which is an essential management document that outlines the scope, schedule and budget for the Authority Program's early delivery objectives. Third, in October 2018 we finalized our Project Management Plan (PMP), which clarifies our integrated organizational framework and presents a governance structure stressing program management and delivery.

As detailed below, we are actively addressing the audit's recommendations through implementation and other remedial steps. As it has done in the past, the Authority will move swiftly to fully implement the recommendations of the State Auditor that bear on the efficacy of program delivery. We hope and trust that our rapid implementation of these recommendations will bolster confidence in the Authority's commitment to active management and continuous improvement of this most important program.

The CSA recommendations and the Authority's responses (in bold) are as follows:

Chapter 1:

The Authority's Decision to Begin Construction Before Completing Proper Planning Led to Cost Overruns and Delays

1. To ensure that the change orders it approves are necessary and that their costs are appropriate, the Authority should adhere to the guidance and estimates the oversight firms provide to it. If the Authority chooses to deviate from the oversight firms' recommendations, it should clearly document why it made those deviations.

   Response:

   The Authority concurs with this recommendation. In 2017, the Authority initiated a governance process to assess the construction, financial, legal and other program perspectives for all changes. The Board of Directors adopted the 2018 Business Plan that included the new governance (see page 63 of the Plan) and adopted the program Baseline in June 2018. The Authority then updated and formalized this process in the Program Management Plan (PMP).

   The current process includes: a Program Delivery Committee, which is a management committee that holds the functional groups accountable for program delivery and evaluates all pending and potential change orders; and a Business Oversight Committee, which acts as a change control committee and must approve all change orders before they go to the Executive Committee and, when needed, the Board of Directors (Board) for approval to execute.

   Each governance committee has an approved charter that outlines its purpose and decision-making authority. In accordance with the CSA recommendation, the Authority will revise the charters to require documentation when a governance committee overrules a Project Construction Management (PCM) firm's recommendation.

   This will be accomplished through a Business Case, which is the document for requesting a proposed change order or a change to the Baseline. The Business Case is required to provide a summary and justification of the recommended actions/changes and includes signatures from the relevant functional, legal, construction and program teams. For construction change orders, the accompanying Business Case will document the PCM recommendation and cost estimate with an explanation of any differences.

   Planned completion date: June 2019

2. Before executing its next construction contract, the Authority should establish formal prerequisites for beginning construction to prevent avoidable cost overruns and project delays. At a minimum, these prerequisites should identify specific benchmarks related to land acquisition, utility agreements and relocations, and agreements with external stakeholders, including impacted local governments and other railroad operators.

Response:

The Authority concurs with this recommendation and has placed significant focus on this issue. The 2018 Business Plan identifies this as a critical lesson learned and it continues to be a point of emphasis (see Chapter 4, Lessons Learned and Managing Risk, page 53 of the Plan). Key among the lessons learned was that the Authority's decision to award design-build contracts before acquiring right of way and completing agreements with utilities, local governments and railroads meant there were many unknowns that created risks of delays and higher costs. The same chapter also describes the governance and management procedures initiated in 2017 to strengthen decision making through a highly structured process, which our response to Recommendation 1 outlines briefly.

More specifically, the Business Oversight Committee considers benchmarks prior to progressing to procurement or to the next phase of project delivery. For example, the Business Oversight Committee would consider the progress of pre-construction activities, including right-of-way acquisition, prior to approving procurement activities to select a construction contractor.

Further, delivering projects in accordance with the Program Baseline, which was adopted by the Board of Directors in June 2018, also ensures that certain predecessor tasks (or prerequisites) are sufficiently advanced prior to beginning construction, as the Baseline incorporates the lessons learned outlined in the 2018 Business Plan. The Authority continues to develop Baseline project work plans composed of discretely defined tasks. These tasks are linked together based on project delivery sequencing, which establishes what tasks must be completed prior to beginning other tasks (i.e., predecessor tasks and successor tasks).

Planned completion dates:

Project Work Plans (with benchmarks) - Draft:	**January 2019**
Project Work Plans (with benchmarks) - Final:	**February 2019**

3. To better position itself to complete the three Central Valley projects by the December 2022 federal grant deadline, the Authority should improve its monitoring and evaluation of the oversight firms' risk assessment processes and should take steps to ensure that these processes are consistent across the three projects by May 2019.

Response:

The Authority concurs with this recommendation. The Authority recognizes the risks associated with complying with the deadline established by the American Recovery and Reinvestment Act of 2009 and is in the process of reorganizing its risk team overseeing the Central Valley projects. It is hiring additional risk management personnel and will prioritize both risk management and mitigation in a way that is consistent across the three construction projects. Further, to verify that the risk assessment processes are consistent across the three projects, the Authority will continue to enforce all policies and procedures related to PCM

oversight, revise the PCM manual to be more explicit on risk management, and will publish a program estimate-to-complete and risk management manual.

Planned completion date: April 2019

4. To enable policymakers and the public to track the Authority's progress toward meeting the federal grant deadline of December 2022, the Authority should, by January 2019, begin providing quarterly updates to the Legislature detailing the progress of the three Central Valley construction projects using an earned value model that compares construction progress to the projected total completion cost and date. The Authority should base these updates on the most current cost estimates available.

Response:

The Authority concurs with this recommendation. The Authority recently developed a Program Delivery Status Report (PDSR) that it produces on a monthly basis. The PDSR includes comprehensive status information within the Authority's three main areas of project delivery: 1) right-of-way procurement, third party agreements, and environmental clearance; 2) engineering/design and construction; and 3) rail infrastructure. This PDSR and associated procedures will be codified within the Program Controls Manual to be published.

The PDSR provides detailed information on the progress of the three Central Valley construction projects within the Infrastructure Delivery section, including cost variance and schedule performance index (SPI).

Moving forward, the Authority will use the most current cost information and an earned value model to refine the cost variance and SPI for each of the three Central Valley construction projects. On a monthly basis, the cost variance and SPI information will be used to estimate the projected total completion cost and date for each of the Central Valley construction projects. This information will be included in the PDSR.

By January 2019, the Authority will use information from the PDSR – including earned value, cost variance and SPI – to develop and provide quarterly updates to the Legislature. The updates will include detailed information on the progress of the three Central Valley construction projects. This information will be used to actively manage the construction projects to ensure that the 2022 federal grant deadline is met.

Planned completion dates:
PDSR Quarterly Update - Draft: December 2018
PDSR Quarterly Update - Final: January 2019
PDSR Manual – May 2019

5. To ensure that it is adequately prepared if it is unable to meet the federal grant deadline of December 2022, the Authority should, by May 2019, develop a contingency plan for responding to such a scenario.

Response:

The Authority concurs with this recommendation. The Authority intends to meet the federal grant deadline and, to achieve that, we continuously monitor and assess the program through the Program Delivery Committee and the Business Oversight Committee. As part of this monitoring process we routinely update the individual project risk registers in coordination with the Federal Railroad Administration (FRA) on a quarterly basis. The Program Delivery

Committee and the Business Oversight Committee use the Project Update Report, Business Plan and Baseline in their monitoring activities. We will continue to assess different contingency plans/options through each of these activities and will prepare a contingency plan in accordance with the CSA recommendation, which will be updated on an annual basis.

Planned completion date: May 2019

Chapter 2:

The Authority Has Not Successfully Enforced the Policies It Implemented to Address Ongoing Deficiencies With Its Contract Management

1. To improve its contract management, increase accountability, and justify the significant amount it pays for contracted services, the Authority should take the following steps by May 2019:

   - Prioritize contract management efforts and reduce the frequency with which contract management responsibilities shift among Authority staff by establishing a formal process for hiring and assigning full-time, experienced contract managers. These contract managers should have duty statements reflecting their contract oversight responsibilities and they should report to supervisors who understand those responsibilities and have extensive knowledge about the contracts' deliverables. In addition, those supervisors' duty statements should clearly lay out their responsibility for addressing any contract manager noncompliance with the Authority's contract management policies and procedures, whether reported by Contract Management Support Unit (CMSU) or identified by another means.

     Response:

     The Authority concurs with the recommendation. The Authority will create a formal process for hiring and assigning full-time experienced contract managers to reduce the frequency with which contract management responsibilities shift among Authority staff. This will include emphasizing contract management experience/skills as well as desirable contract manager qualifications. In addition, all new advertised positions that require contract management will specify the skills required for a contract manager within the duty statement.

     In addition, all existing duty statements will be reviewed and modified to reflect contract management/oversight responsibilities for all contract managers and their supervisors. Contract manager supervisors' duty statements will also address their responsibility to hold their contract management staff accountable for compliance with the Authority's contract management policies and procedures. While only contract managers are currently required to be trained in contract management, contract manager supervisors will also be required to attend contract management training to ensure that the contract managers they supervise are adhering to the Authority's policies and procedures. The Authority will also create a separate contract management training specifically for supervisors.

     Planned completion date: May 2019

- Require CMSU to establish a schedule to monitor individual contract manager compliance and report annually the results of this monitoring to Authority executive leadership. To help ensure the integrity of its oversight role, CMSU should be composed of state staff in place of RDP consultants.

Response:

The Authority concurs with the recommendation. A schedule to monitor contract managers' compliance has been created and assessments of contract manager performance are to begin no later than November 2018, to comply with the Authority's PROC-FIS-038, Contract Compliance Procedure. The assessments will be electronically tracked for resolution status and an executive report will be prepared no less than annually.

In addition, the Authority concurs that CMSU should be composed of state staff. The Authority will prepare a Budget Change Proposal for the 2020/21 fiscal year to request staff augmentation to remove contracted Rail Delivery Partner (RDP) consultants and replace with state employees. (3)

Planned completion date: The contract manager assessment schedule has been developed and the Budget Change Proposal concept will be submitted to the Authority Executive Committee for consideration in May 2019.

- Hold contract managers accountable for performing the duties that the Authority's policies assign to them. Specifically, CMSU and, to the extent necessary, contract managers' supervisors should require and review evidence from contract managers demonstrating their approval of deliverables, detection and resolution of contractor performance issues, and assessment of contract amendments for merit. The Authority should not accept observations and reports from its contractors or RDP consultants in place of this evidence.

Response:

The Authority concurs with the recommendation. The Authority's contract compliance policy POLI-FIS-038 established requirements for performing assessments and reports on contract manager compliance with the Authority's policies and procedures. The Authority will begin performing assessments of contract managers no later than November 2018. We will begin with the contracts identified in this audit and continue until all contracts have been fully assessed.

These assessments will ensure that contract managers are following the Authority's policies and procedures, which are the foundation of a well-managed contract. The assessments will also provide documented evidence that contract managers, not RDP consultants, are properly approving deliverables/invoices, resolving contractor disputes or performance issues appropriately, and justifying contract amendments with verifiable documentation in all contracts. The assessments will not only provide supervisors/management with documentation demonstrating accountability (conformance/nonconformance), but also contain recommendations for best practices and opportunities for improvement.

Once an assessment is issued, it will be tracked to closure/resolution. The process also maintains the tracking mechanism to verify the implementation of the corrective action. This plan provides a framework for review of the contract managers' performance by contract manager and by contract, providing a quantitative assessment of contract manager performance.

Secretary Brian Annis
Page 7
October 22, 2018

Planned completion date: The Authority will begin performing assessments of contract managers no later than November 2018 and anticipates that all contract manager assessments will be completed by or before November 2020 and be ongoing thereafter.

2. To prevent the inappropriate use of contractors to perform state functions, the Authority should develop procedures by May 2019 for evaluating whether new or existing administrative duties should be assigned to contractors or to state employees.

Response:

The Authority concurs with this recommendation. The Authority's Administration Office will develop procedures for evaluating whether new or existing administrative duties should be assigned to contractors or to state employees.

Planned completion date: May 2019

3. To ensure the completeness of contract managers' invoice reviews and that invoiced costs are allowable under contract terms, the Authority should amend its applicable procedures by May 2019 to require contract managers to document their review of invoiced rates and expenses.

Response:

The Authority concurs with this recommendation. As part of a larger plan to revise, field test, and finalize the contract management procedures, the Authority will revise its invoice review procedures (FIS-PROC-033) to require contract managers to document their review of invoiced rates and expenses.

Planned completion date: May 2019

4. To ensure the consistency and effectiveness of its efforts to monitor the performance of the oversight firms with which it contracts, the Authority should develop a formal methodology by May 2019 for using the performance evaluation tool it has implemented. This methodology should include procedures for assessing the sufficiency of the oversight firms' review and approval for construction contracts.

Response:

The Authority concurs with this recommendation. The Authority has developed and implemented monthly performance-based evaluations for its construction oversight firms that are updated by each contract manager. A formal methodology will be developed for the performance evaluations. Contract Performance Monitoring and Reporting Policy POLI-FIS-034 and Procedure PROC-FIS-034 will be revised to document this formal methodology.

The Authority's contract manager and quality team will evaluate the PCM's procedure for compliance with section *3.9 Contractor's Monthly Payments* of the Project and Construction Management Manual (For Design-Build Contracts) on all construction packages; specifically, for the purpose of assessing construction progress to validate invoice submissions and earned value from the design-builder. The Authority will amend its Quality Manual to reflect this process and the frequency of the assessments. Any non-conformance will be formally documented.

Planned completion date: May 2019

Secretary Brian Annis
Page 8
October 22, 2018

5. To ensure oversights firms' spending is reasonable, the Authority should develop a formal process by May 2019, for tracking any out-of-scope work the oversight firms perform. To reduce the likelihood that its contracts with these oversight firms run out of funds prematurely as a result of this additional work, the Authority should also develop a formal process for amending these oversight firm's contracts contemporaneous to change orders that significantly extend timelines or increase the scope of work of the construction contracts that they oversee.

   Response:

   The Authority concurs with this recommendation. The June 2018 Program Baseline, approved by the Board of Directors, details the scope, schedule and budget for all work on the high-speed rail program, including PCM firms' contract budgets and schedule. Any PCM contract amendment requires approval from the Business Oversight Committee. As outlined in the response to Recommendation 1, the Business Oversight Committee requires a Business Case with subject matter expert signatures before considering any contract change. Additionally, the Authority will revise the PCM manual to reflect their responsibility to identify, manage and request amendments for out-of-scope work. The PCM contract managers will separately be responsible for tracking and identifying any potential out-of-scope work and the necessity to amend contracts at each PCM work plan revision and approval.

   The Program Delivery Committee is responsible for governance oversight of contracts and will consider the impact on PCM contracts by programmatic trends (such as schedule delays) or changes approved by the Business Oversight Committee (such as a change to a design-build contract). A key component of Program Delivery Committee meetings will focus on upcoming key milestones and decision-points, including when or if contracts need amending.

   Planned completion date: May 2019

Chapter 3:

The Authority Can Improve the Quality and Transparency of Its Monitoring and Reporting for Key Goals

1. To help improve the effectiveness of its sustainability policy, the Authority should revise the policy by May 2019 to more clearly differentiate between construction and operation phases of the high-speed rail system. Further, it should ensure that each objective in each section of the policy is associated with quantifiable metrics for evaluating implementation.

   Response:

   The Authority concurs with this recommendation. The Authority will revise its Sustainability Policy to more clearly differentiate between construction and operations. Since the end of audit fieldwork, the Authority has revised the implementation plan to match each existing policy objective with a quantitative metric, posted here:
   http://www.hsr.ca.gov/docs/programs/green_practices/sustainability/Sustainability_implementation_plan_SUMMARY_Oct2018.pdf .

   Planned completion date: The Policy will be updated by May 2019.

2. To allow it to evaluate the sustainability of the high-speed rail system's construction, the Authority should perform and document a review of its compliance with its existing quality controls related to ensuring the validity and completeness of contractor-reported data by May 2019. The Authority should also establish a formal process to perform such reviews periodically.

Secretary Brian Annis
Page 9
October 22, 2018

Response:

The Authority concurs with this recommendation. The Authority improved its environmental and sustainability data gathering and analysis system in July 2017. As an additional improvement, the Authority will develop a quality assurance process to perform periodic reviews of its compliance with the quality controls related to validity and completeness of contractor-reported data.

The updated system has a data field validation feature, which is a quality control measure that involves a cross check at the data entry level, next level review and confirmation of data by PCMs, and a final data quality review and acceptance by the Authority. This process is enforced by the system and is ongoing and continuous. The recommended periodic reviews will verify that the above-described controls are functioning as expected.

Planned completion date: May 2019

3. To help ensure it meets its sustainability goals, the Authority should comprehensively compare the three construction project's performance to their construction contractors' original baseline estimates on a quarterly basis by May 2019.

Response:

The Authority concurs with this recommendation. Since 2015, the Authority has collected and organized data which it uses to analyze construction activities related to air quality and greenhouse gas emissions. The Authority then compares that to the contractually identified baseline estimates; this comparison is done on a quarterly basis. The Authority compares the contractor's required performance for waste, absolute targets for recycling of concrete and steel and a percentage target for remaining nonhazardous waste, as recycling records are submitted. Other sustainability performance tracking, related to fuel usage, water usage, and recycling, had previously been analyzed and compared to baseline estimates on an annual basis. The Authority will begin comparison of these performance areas on a quarterly basis and will adjust the analysis to include the relationship to construction progress.

Planned completion date: May 2019

4. To help ensure that its contractors proposed environmental impacts are reasonable and to measure the progress of its sustainable construction efforts over time, the Authority should, by November 2019, identify and track standardized measure – such as project miles – that will allow it to compare construction impacts across the high-speed rail system's different construction projects.

Response:

The Authority concurs with this recommendation. Currently, the Authority has a model that assesses program environmental impacts using standardized metrics, including tons of CO_2e, $kgCO_2e/kg$, $kgCO_2e/gallon$, $kgCO_2e/kWh$, normalized by miles and construction typology. The Authority is in the process of updating this model to incorporate refined project lengths and infrastructure typologies adopted in the Baseline and to incorporate relevant, validated data (e.g., tons of CO_2e and environmental product declarations for actual materials installed) tracked on each construction package. This updated model will allow comparison across construction projects and support establishing targets for future construction contracts.

Planned completion date: November 2019

Secretary Brian Annis
Page 10
October 22, 2018

5. To increase the transparency of its reporting, the Authority should, by May 2019, expand its quarterly small business, DBVE, and DBE utilization reporting to account for the total value of all its contracts and to identify the reasons it has exempted specific contracts.

Response:

The Authority concurs with this recommendation. In an effort to increase transparency, the Authority will post the total value of all current contracts within the Small Business Program section of the Authority's website. The Authority will also post the total value of any contracts that require small business, DVBE and/or disadvantaged business, which will appropriately reflect the Authority's utilization percentages per state and federal guidelines.

While the Authority reports utilization on a quarterly basis for federally funded contracts, the state process, administered by the Department of General Services, only requires an annual report from all state agencies/departments. However, the Authority will create an internal process to closely align the state timeline to the federal quarterly process. In addition, a policy will be created that will clearly specify what contracts are exempt from small business, DVBE and/or disadvantaged business according to state and/or federal regulations, policies, and guidelines.

Planned completion date: May 2019

Again, we appreciate the opportunity to provide a response to our plans to implement the California State Auditor's recommendations. If you have any questions, please contact Paula Rivera, Chief Auditor, at paula.rivera@hsr.ca.gov or (916) 403-2679

Sincerely,

for Brian P. Kelly
Chief Executive Officer

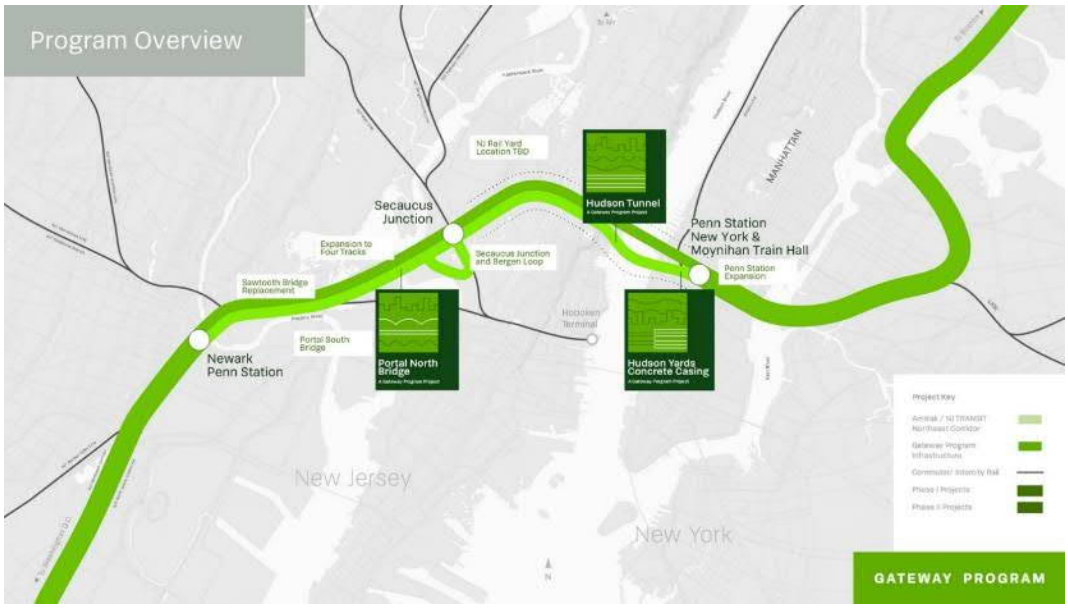
GATEWAY PROGRAM, NEW JERSEY/NEW YORK

PROGRAM OVERVIEW

Program Description

Gateway Program is a comprehensive program of strategic rail infrastructure improvements to improve rail services and create new capacity along a 10-mile segment of the Northeast Corridor between Newark, New Jersey, and Pennsylvania Station in New York City (PSNY) (Figure 14). The program will replace and update rail infrastructure assets and increase track, tunnel, bridge, and station capacity to double the number of passenger trains crossing under the Hudson River. In addition, the program will increase resiliency and provide redundancy along the Northeast Corridor by repairing the corroded and damaged components of the North River Tunnel, which was inundated with seawater during Superstorm Sandy in 2012. The Northeast Corridor is a critical regional transportation corridor, providing vital connections to and from core economic centers.

Figure 14: Gateway Program Overview



Source: Gateway Program, http://www.gatewayprogram.org/about.html

The program is in the planning and the design phase; two Phase 1 programs, the Portal North Bridge and the Hudson Tunnel, are currently underway. The Portal North Bridge (Figure 15) will replace the functionally obsolete Portal Bridge with a new high-level two-track fixed span. This new bridge will increase rail transit capacity by an estimated 11% and improve service reliability. Early construction work for this bridge began in the fall of 2017. The Hudson Tunnel Program includes construction of a new two-track Hudson River rail tunnel and rehabilitation of the 108-year-old North River Tunnel to provide redundancy and operational flexibility. The program is currently in the environmental review process. Another program included in the first phase of the program is construction of a concrete casing at Hudson Yards in Manhattan to preserve the right of way for the future tunnel to PSNY. Construction has been completed for two of the three sections; the third section is fully permitted and designed, but additional funding is needed to complete the program.

Figure 15: Artist's Rendering of Future Portal North Bridge

Source: Amtrak, Portal Bridge Replacement Program

Subsequent phases of the Gateway Program will include replacement of the Sawtooth Bridges, the expansion of PSNY, the expansion and modification of Secaucus Junction Station and addition of loop tracks in New Jersey, the construction of the Portal South Bridge, and other elements to complete a four-track railroad between Newark Penn Station and PSNY.

The Gateway Program was introduced in 2011, after a similar program, Access to the Region Core (ARC), was cancelled by Chris Christie, then governor of New Jersey, citing potential cost overrun exposure to the state. ARC was a commuter rail program that was proposed to increase service capacity of New Jersey Transit service between New York and New Jersey along the Northeast Corridor; it was estimated to cost $8.7 billion.

Responsible Agency

Gateway Development Corporation (GDC) was created in 2016 to oversee the implementation of the Gateway Program. GDC is a partnership between the State of New York, State of New Jersey and Amtrak.

Estimated Program Costs and Completion Dates

When the Gateway Program was unveiled in 2011, it was programed to cost $14.5 billion and take 14 years to build. Currently, the program is estimated to cost $30 billion, which includes $12.9 billion for the Hudson Tunnel program and $1.5 billion for Portal North Bridge. The completion date for the program is currently unknown; however, the Hudson Tunnel is expected to be completed in 2030 and Portal North Bridge is expected to be completed in 2024.

GOVERNANCE/DECISION-MAKING/PROGRAM MANAGEMENT

Program Organization and Evolution

GDC was created from a call to action in November 2015 by the former U.S. Secretary of Transportation, Anthony Foxx; New York Governor Andrew Cuomo; New Jersey Governor Chris Christie; and U.S. senators Charles E. Schumer, Robert Menendez and Cory Booker. Founded in 2016 as a nonprofit corporation under New Jersey law to effectuate planning, funding/financing, construction and delivery of the Gateway Program, GDC was set up as an independent third party with fiduciary responsibility. GDC was chartered to issue debt, act as a grant recipient (with state/federal action) and loan recipient, and shield the Port Authority of NY/NJ, New Jersey Transit, Amtrak and the 2 states from financial liability.

GDC is currently composed of four staff members: Executive Director, Chief Administrative Officer, Secretary and General Counsel, and Chief of Public Outreach. GDC is operating primarily through additional staff provided by Port Authority of New York & New Jersey (PANYNJ), but also supported by numerous staff from other partner agencies, including Amtrak and New Jersey Transit.

GDC is governed by the GDC Board of Trustees, which initially included four members representing Amtrak, the State of New York, NJ Transit, and the U.S. Department of Transportation (USDOT) However, the USDOT withdrew from the Board in 2017, citing a conflict of interest in that it is not typically standard practice for the USDOT to serve in such a capacity on local transportation programs. For the remaining three GDC trustees, appointments are made by Amtrak, Commissioner or Acting Commissioner of NY State DOT, and governing body of NJ Transit. The appointments of the GDC trustees are detailed in the Bylaws of the Gateway Development Corporation (amended and restated as of September 15, 2017).

The GDC trustees meet every other month to discuss the program. In addition, a formal session is held monthly so that the Executive Director can provide the Board with a

status update. The GDC trustees provide a key avenue for coordination with the other partner agencies.

Although GDC was originally chartered to receive grants and loans, because GDC is a nonprofit corporation, it is not ideally structured to do so. GDC is in the process of creating a new bi-state commission, the Gateway Development Commission, that would mirror the existing nonprofit corporation and enable the governing body to meet the requirements for federal funding (e.g., nonprofits currently cannot be a recipient of Federal Transit Administration Capital Investment Grant [FTA CIG] funding). Establishment of the Gateway Development Commission requires identical legislation in both New York and New Jersey, which is currently under consideration in both states. This would enable the Gateway Development Commission to serve a lead role in the financing and development of the Gateway Program, including acting as a federal grant and loan applicant and recipient, and as a National Environmental Policy Act (NEPA) program sponsor

Key Decision-Making Mechanisms and Responsibilities

The GDC Board of Trustees makes decisions at the direction and on behalf of the states of New York, New Jersey and Amtrak.

Program Management and Oversight Approach

GDC is responsible for providing day-to-day program management and oversight for the program. Each program has an agency that is responsible for construction and program management (e.g., New Jersey Transit is responsible for construction and program management of the Portal North Bridge program).

Lessons Learned

Considerations for governance should include:

1. Federal grant and loan eligibility
2. Durability of federal commitment to the program
3. Ownership
4. Program delivery capacity
5. Maintenance and operations responsibility
6. Liability
7. Enabled powers and abilities of member organizations
8. Political resiliency
9. Gateway governance program responsible for timely and effective program delivery

The governance composition should ensure program longevity so that as elected officials change, these changes would not unilaterally result in the program's cancellation. This program of programs will span multiple gubernatorial administrations in two states.

Building federal support across multiple administrations is challenging, but essential to the program's longevity. In addition, stakeholder involvement from the beginning is critical so that the program has the support and momentum it needs to move forward.

FINANCE

Program Finance Mechanisms and Sources

The State of New Jersey, the State of New York, PANYNJ, and GDC will fund 50% of the Gateway Program and federal partners (Amtrak, FTA, and Federal Railroad Administration [FRA]) will fund the other 50%.

GDC has signed an Emerging Programs Agreement with USDOT, which is designed to give GDC access to low-cost federal loans. GDC will be the borrower with debt to be paid by funding provided to GDC by local partners. It is important to note, however, that Gateway is presently politically prohibited from access to the federal loan programs by USDOT.

The Portal North Bridge has been accepted into the program development pipeline for the FTA Core Capacity grant program, which is being requested to provide $811.1 million to the program. In addition, the Federal Highway Administration (FHWA) Flexible Funds (Congestion Mitigation and Air Quality Program [CMAQ]) will provide $81.6 million and FRA Amtrak funds will provide $21 million. State funding commitments include $499.4 million from New Jersey Economic Development Authority bonds, $208.4 million from New Jersey Transportation Trust Fund revenues, and $20.4 million from NJ Transit (as a local match to CMAQ from NJTTF revenues). Local funding commitments include $284 million from a Transportation Infrastructure Finance and Innovation Act (TIFIA) loan and $21.6 million from PANYNJ revenues.

The Hudson Tunnel was accepted into the program development pipeline for the FTA New Starts grant program, which is being requested to provide $6.8 billion to the program. Local funding plans to date include $6.1 billion in Railroad Rehabilitation and Improvement Financing (RRIF) loans ($2.1 billion repaid with PANYNJ funds and $1.7 billion repaid with New York State funds, $1.5 billion repaid with NJ Transit funds, and $787.7 million repaid with local revenues), $524.2 million from GDC funds from New York State and NJ Transit, and $269.8 million from GDC funds from PANYNJ payments.

Challenges with Securing Funding

The withdrawal of the USDOT from the GDC Board of Trustees and ongoing debate about inclusion of the program in federal transportation budgeting.

In December 2016, Amtrak published The Economic Benefits of Investment in the Gateway Program, which summarizes the economic benefits delivered by the Gateway Program. The report emphasizes the program's importance to moving people to an economic core amid the current transportation infrastructure's limited capacity to accommodate additional growth. In addition, a recent report by the Regional Plan

Association estimates that the prolonged closure of one of the two existing tubes for rehabilitation (if that is required before the new tunnel opens) would result in approximately $3 billion in 2015 dollars in economic losses.

Lessons Learned

Although the Gateway Program is facing uncertainty, a key lesson learned is to ensure the program is ready to get in the queue for funding when it becomes available (e.g., stimulus bill or surface transportation authorization bill), especially since other mega-programs will also be in competition to receive the same funding sources. In addition, a program of this size needs to rely on funding commitments and agreements between partner agencies to help push the program forward to the finish line.

Although funding has not been secured for the entire program, the program's momentum has been maintained with sufficient funding from the partner agencies to keep the Portal North Bridge and the Hudson River Tunnel programs moving forward.

An economic analysis (and benefit cost analysis) of a mega-program (such as The Economic Benefits of Investment in the Gateway Program) of large size and significance can aid the case for funding and is a critical part of key decision-making.

PROGRAM DELIVERY APPROACH

Program Delivery Approach

The Gateway Program delivery approach incorporates the delivery of the individual programs. The program delivery approaches for the Portal North Bridge is traditional design-bid-build (the program is 100% designed and permitted), and the Hudson River Tunnel program delivery approach is still to be determined. The recent conclusion of an RFI process for the tunnel will help determine the delivery approach.

Key Challenges and Resolution Mechanisms

There have not been any audits conducted on the Gateway Program.

Perhaps one of the greatest challenges that the Gateway Program is facing is the lack of partnership within the current White House Administration to help drive the program forward. The withdrawal of the USDOT from the Board of Trustees, refusal to sign the tunnel EIS Record of Decision, refusal to issue Letters of No Prejudice (LONP), and denial of access to federal infrastructure loan programs has left the Gateway Program without a federal partner to help guide, advocate and co-fund the program. However, the Gateway Program still has strong commitment from the New Jersey and New York governors, their agency partners, and the Congressional delegations from New York and New Jersey to advance the Portal North Bridge and the Hudson River Tunnel programs and subsequent programs in the program.

Lessons Learned

Federal involvement is critical for both the political resiliency of a program and funding commitment.

RISK MANAGEMENT

Risk Management Approach

Risks have been evaluated in terms of program cost, but a formal risk management approach has not been put in place yet. In addition, the Interim Executive Director is working on risk allocation for the contract of the Hudson Tunnel.

CONCLUSION

Despite the uncertainty that lies ahead for the Gateway Program, stakeholders recognize its importance as a transportation program to the Northeast Corridor and the long-term economic impacts to the region. GDC's initial governance structure evolved in part, due to the USDOT's withdrawal, but also due to the realization that nonprofit corporations are not be eligible to receive federal grants and loans, and this deficiency was not going to be corrected at the federal level. These shifts drove changes to the governance structure, and as the program continues to evolve and advance, more changes may be anticipated to ensure the structure reflects the needs of the program's current phase.

LONDON CROSSRAIL, LONDON

PROGRAM OVERVIEW

Program Description

The London Crossrail Program is a 73-mile (117-kilometer) rail line crossing Central London from east to west, stopping at more than 40 stations, including 10 new stations and 26 miles (42 kilometers) of new tunnels (Figure 16). At each end of the central core of the line, the line divides into two branches: one to the west that serves the Reading and Heathrow Airport stations and one to the east serving the Abby Wood and Shenfield stations. The new rail corridor has been one of the most technically difficult construction programs in the world because it includes 13 (21 kilometers) miles of tunneling below the historic and architecturally significant center of the City of London. In addition, an almost entirely new rail branch, from the mainline at Whitechapel Station to the Canary Wharf Station under the River Thames, is part of this program. The program includes rehabilitating older stations and two new depots in west London at the Old Oak Common area and east of London at the new Romford center. The entire program of new rail construction/stations will be called the Elizabeth Line (Figure 17).

The rail line will include the operation of new nine-car train sets, running at frequencies of up to 24 trains per hour in each direction.

A 2014 audit of the program by the National Audit Office listed the objectives of the new railway are to:

1. Relieve congestion to the transport network in and around London;
2. Accommodate future travel demand growth;
3. Improve connectivity and reduce journey times; and
4. Deliver wider economic impacts, including supporting economic growth.

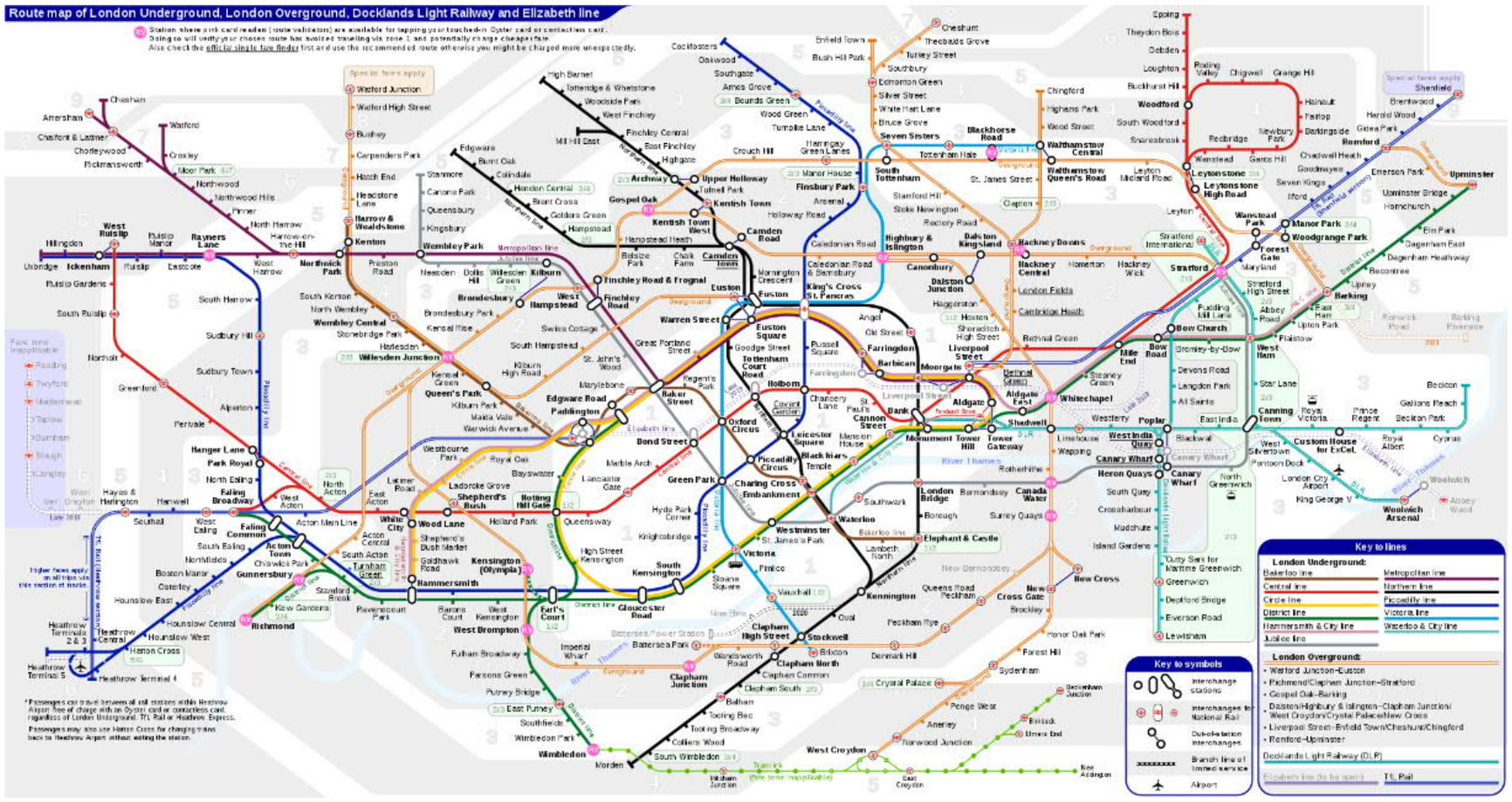
Responsible Agency

Per the National Audit Office, the national “Department of Transport and Transport for London (TfL), are jointly sponsoring the Crossrail program. Crossrail Ltd, a wholly owned subsidiary of TfL, is responsible for delivering an operational railway. Network Rail is undertaking work to improve existing surface infrastructure to meet the needs of the new service.” In July 2014, TfL awarded the contract to operate the Elizabeth line service to MTR Crossrail (Hong Kong).

Estimated Program Costs and Completion Dates

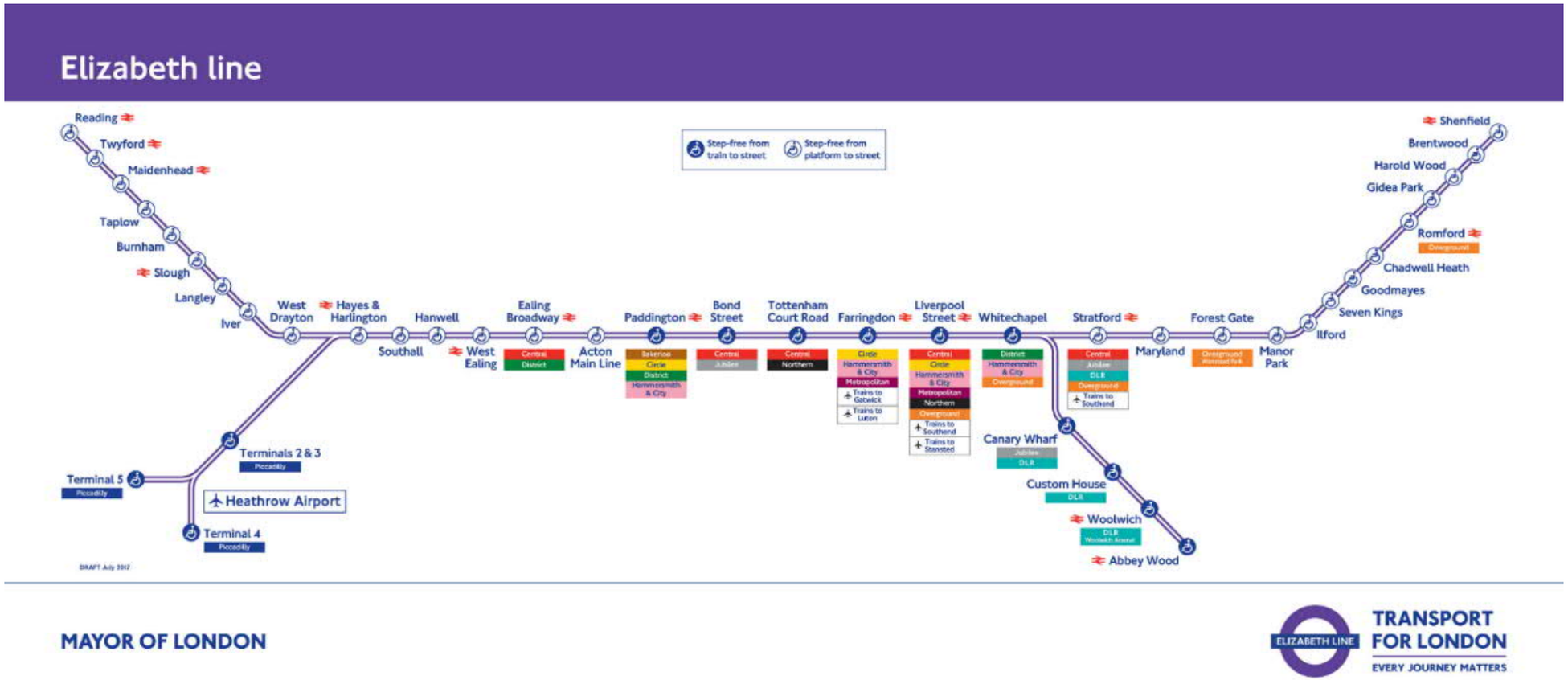
The London Crossrail program was approved by the Department of Transport in 2007, with construction beginning in 2009. For the last several years, the program was estimated to cost £15.4 billion with completion/start-up expected in December 2018. In May 2019, the cost estimate was revised to £17.6 billion with estimated completion/start up shifted to a six-month range: October 2020 to March 2021; without including a specific opening date. The reasons for the shift in schedule and increased program costs are principally based on the lack of integration of the program's complex signal, power and communications systems.

Figure 16: Integrated Route Map Including London Underground and Crossrail Lines



Source: Sameboat, Wikimedia Commons/TfL

Figure 17: Crossrail Elizabeth Line Route Map



Source: Transport for London (TfL)

GOVERNANCE/DECISION-MAKING/PROGRAM MANAGEMENT

Program Organization and Evolution

The Department of Transport and TfL are joint sponsors of the Crossrail program. The Sponsor Board also includes Crossrail Ltd, which is responsible for the implementation of construction and implementation of the railway.

Major stakeholders in the Crossrail program (Figure 18) throughout the construction of the railway included the following:

Figure 18: Crossrail Program Major Stakeholders

Key players

1.7 **Figure 3** shows the roles and responsibilities of the organisations involved in Crossrail.

Figure 3
Major stakeholders in Crossrail

Organisation	Role
Department for Transport	Joint sponsor and funder
Transport for London	Joint sponsor and funder
Crossrail Limited	Wholly-owned subsidiary of Transport for London, delivering the Crossrail programme
Crossrail Project Representative	A senior engineer, supported by a small team, who challenges and reviews Crossrail Limited's progress with the programme, and reports to the joint sponsors
Network Rail	Financing the surface works through borrowing which will primarily be repaid by fees from the Crossrail train operating company. Network Rail is also a contractor to Crossrail Limited for the construction of the eastern and western surface sections in addition to its wider responsibility for the national rail network
Bechtel	Project management contractor, working with Crossrail Limited to oversee construction of the central, tunnelled section
Transcend (joint venture between AECOM, CH2M Hill and Nichols Group)	Project management contractor, working with Crossrail Limited to oversee the overall Crossrail programme
City of London Corporation Heathrow Airport Limited	Agreed to contribute funding towards Crossrail
Canary Wharf Group	Contributing towards the construction of the Crossrail station at Canary Wharf
Berkeley Homes	Contributing towards the funding of the Crossrail station at Woolwich
Office of Rail Regulation	Regulating Network Rail

Source: National Audit Office

Following the major schedule and cost information that was beginning to be made public between 2015–2017, KPMG was tasked by the Department of Transport and TfL to prepare an independent review of Crossrail's governance and program management.

In a report released in January 2019, KPMG concluded that:

> "This report recommends changes to governance to reflect the stressed status of the program, to align the structure with the now changed current and expected program requirements through to completion, and to facilitate Sponsors to achieve/sustain more effective oversight. Given the state and complexity of the remaining programme, a completely new governance structure is not considered appropriate as it would potentially introduce significant risk to the program."

Key Decision-Making Mechanisms and Responsibilities

The decision-making mechanisms and responsibilities of program management have not changed throughout the evolution of the London Crossrail program; however, the individuals in those positions have changed.

Per the 2019 KPMG independent report, "The Chair of the London Crossrail Limited Board has resigned, a replacement is being sought, and there is a new Executive management team in place within Crossrail Limited. The new Chief Executive Office and Finance Director are both Transport for London secondees.'" The program is still jointly controlled by the Department of Transport and TfL. Program implementation still rests with Crossrail Ltd.

Program Management and Oversight Approach

A 2014 National Audit report on the governance and oversight of the Crossrail program stated that the "Department for Transport and Transport for London had established a governance and oversight protocol that provided a clear view of risks to their financial interests and to the successful delivery of the program." Furthermore, this national audit report concluded that: "During the construction phase, the governance arrangements and oversight of the program have ensured tight management of the programme so that delivery to both cost and schedule are well managed."

Also in 2014, the British Public Accounts Committee (PAC) report stated:

> "The Crossrail programme is proceeding well and is on course to deliver value for money to the taxpayer. The joint sponsors of the Crossrail programme, the Department of Transport (the Department) and Transport for London, are working well with the delivery organization, Crossrail Limited, to deliver the programme, which at present is broadly on schedule and being delivered within budget."

By 2017, that conclusion had been radically updated with new audits indicating that although the construction phase of the program had been successful, the program had

failed to account for sufficient time to integrate three different signal systems and test those systems effectively while implementing the complex power, communications and signal system requirements for revenue service along the line and specifically at new and renovated rail stations. In other words, despite warnings of risks in these areas in 2014, Crossrail Ltd did not factor in risk mitigation procedures which would allow for earlier testing of the system and integrated operations considerations during the design phase of the program.

New oversight recommendations (as stated in the KPMG 2019 Report) have included:

1. "Maintaining the separation between Sponsors and Crossrail Ltd and enhancing the behaviors which underpin transparency;
2. Enable enhanced reporting at all levels;
3. Sponsors to encourage and ensure the fostering of an enhanced culture and environment within Crossrail Ltd to provide performance information, especially when programme performance and/or expected outcomes may not be in line with Sponsor expectations";
4. Sponsors to consider appointing an Independent Member to the Sponsors Board (SB) to support Sponsors in their decision-making;
5. "Each Sponsor should consider the appointment of a Voting Member of the SB as an observer at London Crossrail Ltd Board meetings".

Lessons Learned

The lessons learned on the London Crossrail Program regarding decision-making include the following:

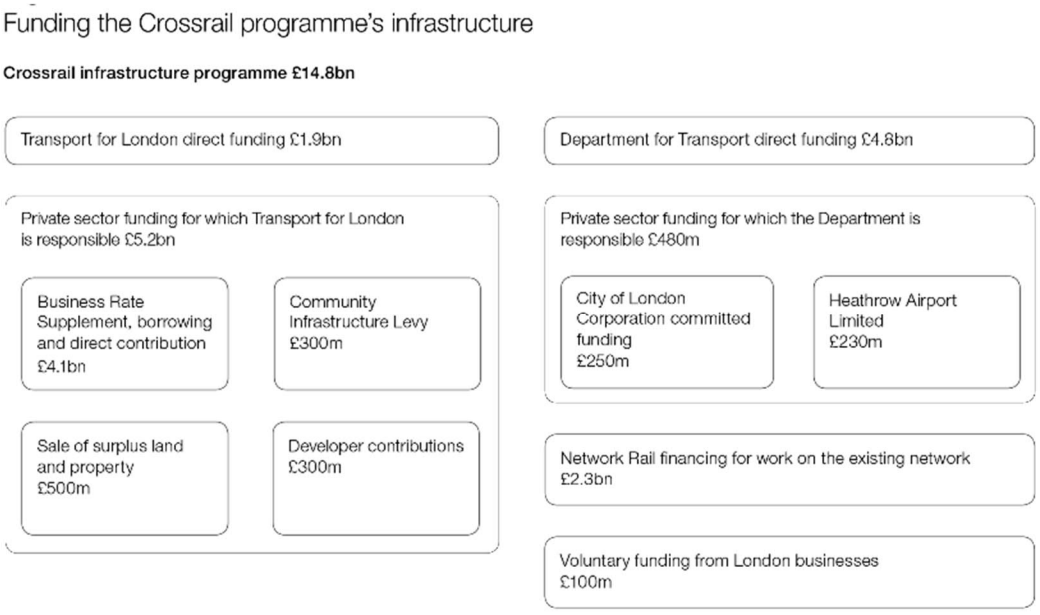
1. Risk identification and mitigation must be raised to the executive level when they are known.
2. Decision-makers should have experience in the work of the current phase of the program. Many of the individuals responsible for the successful early phases of the program's completed construction did not have a background in operations or systems integration at this crucial phase of implementation.
3. Enhanced reporting and transparency are critical to the effective management of a mega-rail program.

FINANCE

Program Finance Mechanisms and Sources

Program financing for the Crossrail Program, when the program was estimated to cost £15.4 billion included the following funding sources in 2014 (Figure 19):

Figure 19: Crossrail Program Funding Sources, 2014.



Source: National Audit Office analysis of data from Department of Transport, TfL and Crossrail, Ltd

Following the announcement that full program's costs were estimated to rise by approximately £2 billion in July, 2018, additional funding sources were added to the previous funding sources. Per the independent review of Crossrail's financial and commercial assumptions as documented in the 2019 KPMG report:

> "The Mayor of London and the Government (Department of Transport) agreed to a financial package to fund additional costs. The Greater London Authority (GLA) will borrow up to £1.3 billion from the Department of Transport. The GLA will repay this loan from the existing Business Rate Supplement (BRS) and the Mayoral Community Infrastructure Levy (MCIL). The GLA will also provide a £10 million cash contribution, taking its total contribution to £1.4 billion which it will provide as a grant to Transport for London for the Crossrail program."

In other words, the program cost increases and schedule delays that were announced in 2019, resulting in the programed £2 billion increase to deliver Crossrail, will be paid by direct grants and loans by the Mayor of London and Greater London Authority and financed via a London area Business Rate Supplement.

Challenges with Securing Funding

Funding challenges to the completion of the London Crossrail program have been addressed. The original funding sources remain in place. The additional costs of the program will be funded as noted above.

It should be added that all levels of the program's sponsors moved relatively quickly in addressing this funding challenge in approximately one year. As this program is generally Britain's highest- priority infrastructure program, it has a stature and the involvement of numerous and powerful stakeholders.

Lessons Learned

Mega-rail programs may experience funding shortfalls due to a variety of conditions that may be noted in a risk register but lack adequate mitigation funding because the complexities of multiple systems integration is not clearly understood. This is particularly true when programs merge alternative signal, communication and power systems within a program that has been constructed via simultaneous design and construction contacts.

PROGRAM DELIVERY APPROACH

Program Delivery Approach

As the responsible party for the delivery of the Crossrail program, Crossrail Ltd oversaw acquiring design and engineering contracts, as well as construction contractors. The approach was to develop a series of "Enabling Works Frameworks" for different elements of the program. These frameworks, or agreements, were approved by the Crossrail Ltd Board of Directors and the Sponsors Board. For example, design work agreements were set in place for station design, tunnel design and railway systems design, and with the firms preapproved for this work competing on a task order/contract basis.

Based on a Crossrail Ltd bid process, a pool of consultants or contractors were authorized to compete within their area of expertise at certain phases of the program to assess qualifications for doing selected design work. This approach reduced the amount of time for large procurements and generally resulted in fewer qualified bids, but also required simultaneous oversight of as many as 36 major contracts.

Sponsor Board members, such as Network Rail, also received contracts for rail operational needs because of their responsibilities within TfL.

KEY CHALLENGES AND RESOLUTION MECHANISMS

Lessons Learned

This delivery strategy did allow construction to move quickly. However, the oversight and integration of construction contract work ongoing simultaneously with design work for stations, for example, resulted in rework and schedule delays at stations to accommodate station and systems infrastructure. Adequate integration analysis, testing and commissioning time must be included in a mega-rail program schedule, particularly when complex communications, power and signal systems are being merged.

RISK MANAGEMENT

Risk Management Approach

Based on KPMG's analysis of Crossrail Ltd's risk management approach in their 2019 report to the TfL and the Department of Transport, the program relied on financial models tracking infrastructure risks, dynamic testing risks and catastrophic risks being modeled together using a Monte Carlo analysis.

KPMG concluded that:

> "While this is a reasonable approach for modelling risk generally, modeling of the high-impact/low-probability risks (strategic risks) results in contingency sums which are far lower than would be required should those risks materialize."

Recommendations to remedy this situation as the program moves forward include:

1. Development of a bottom-up cost estimate built on dates drawn from an updated Master Operational Handover Schedule (MOHS).
2. Development of a consistent approach in the future modeling of schedule risk, commercial risk and contingencies.
3. Requests from the Sponsor Board for regular updates of this new approach at its Board meetings.

CONCLUSION

The London Crossrail program is an urban rail program that relied on previous construction and implementation successes in meeting budget and schedule objectives. Given this program's "culture of confidence," there was no possibility of failure considered for the "softer" sides of implementation.

The failure to address the system-related risks outlined in reports to executive leadership contributed to this program's failure to meet schedule and budget objectives in the latter phases of implementation.

The program has implemented major personnel changes to reflect leadership experience specific to the current phase of the program's implementation.

Risk reports are now reviewed at executive leadership levels in detail and risk mitigations are acted upon promptly.

Executive leadership positions and Board members should reflect skills and experience consistent with the current phase of the program's implementation.

SAN FRANCISCO-OAKLAND BAY BRIDGE EAST SPAN REPLACEMENT, CALIFORNIA

PROGRAM OVERVIEW

The San Francisco-Oakland Bay Bridge East Span Replacement program replaced 2.2 miles of the east span with a self-anchored suspension (SAS) bridge. The original east span collapsed during the Loma Prieta earthquake in 1989, and although it was reconstructed and repaired, the span needed to be replaced to be seismically sound in the event of another earthquake.

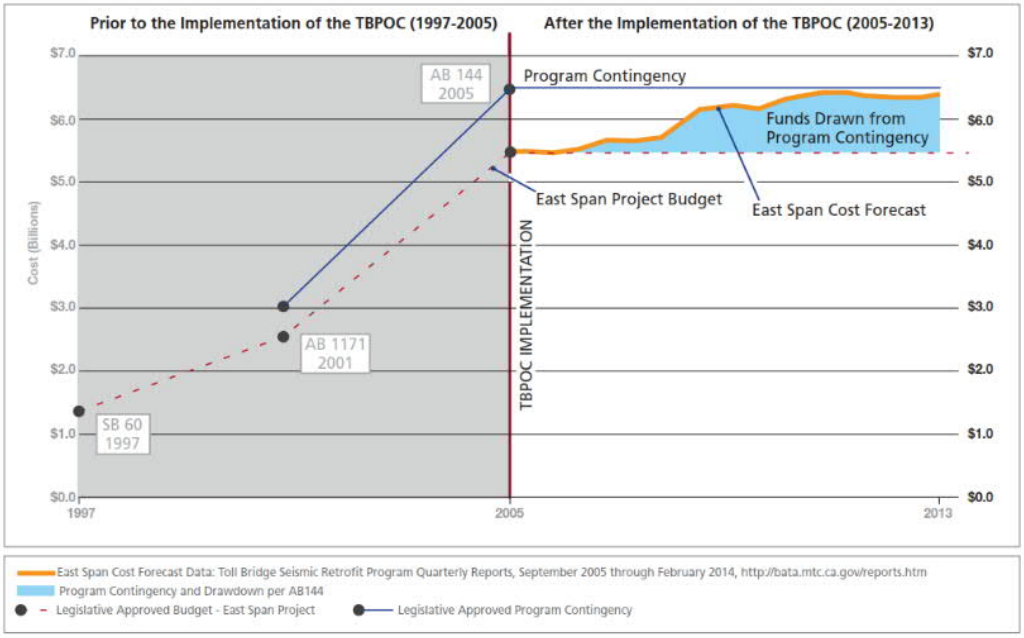
The California Department of Transportation (Caltrans) District 4 was initially the agency responsible for overseeing the program, but that responsibility was eventually divided between Caltrans, the Bay Area Toll Authority (BATA), and the California Transportation Commission (CTC) after the passage of Assembly Bill (AB)144 in 2005 and the formation of the Toll Bridge Program Oversight Committee (TBPOC).

The program was estimated to cost $1.3 billion in 1997 at its initiation, but after changes to the design and additional costs that were not initially accounted for, the cost increased to $2.6 billion in 2001 with estimated completion in 2007. When the program was finally completed in 2013 (Figure 20), the cost had increased to $6.4 billion. Figure 21 below illustrates how the cost forecast changed over time, prior to the implementation of TBPOC (1997-2005), and after (2005-2013).

Figure 20: New East Span of the San Francisco-Oakland Bay Bridge

Source: San Francisco-Oakland Bay Bridge Seismic Safety Programs

Figure 21: East Span Program Cost-Forecasting History



Source: San Francisco-Oakland Bay Bridge Seismic Safety Programs

GOVERNANCE/DECISION-MAKING/PROGRAM MANAGEMENT

Program Organization and Evolution

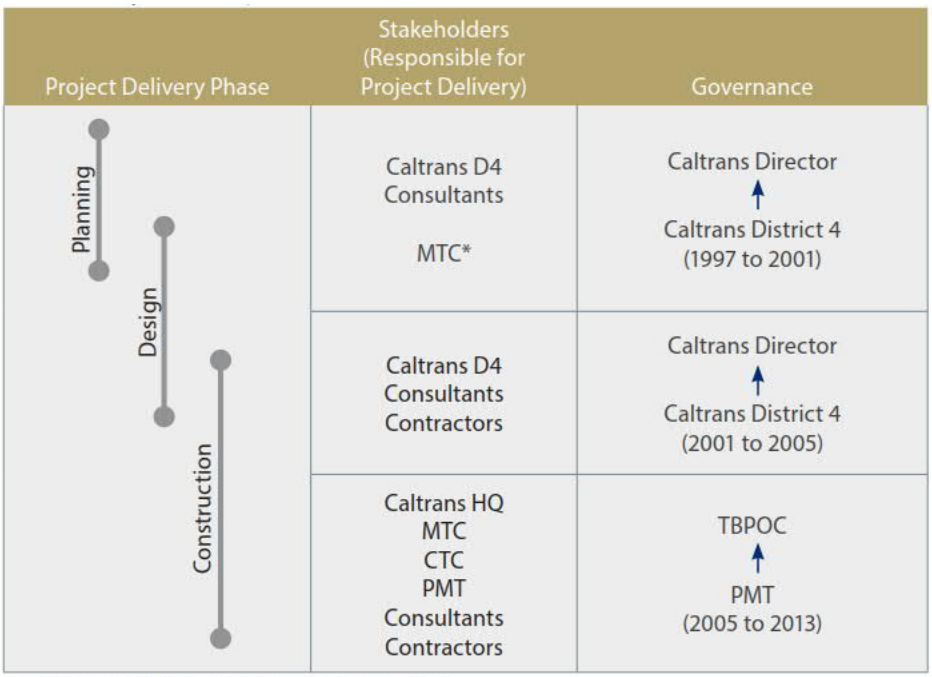
The East Span Replacement program was managed by Caltrans District 4, with regular reporting to the Caltrans Director, during the initial planning and environmental assessment phases of the program (with assistance from the Metropolitan Transportation Commission [MTC] with selecting the bridge type). Since the program was unlike any program that Caltrans had delivered previously, the organization structure was revised (from the typical Caltrans discipline matrix) so that the major discipline managers reported to the program manager. When the original Caltrans District 4 Toll Bridge Program Manager departed in 2001, the Caltrans Program Manager assigned to District 4 from Sacramento assume responsibility for managing day-to-day activities.

In 2004, the Bureau of State Audits (BSA) conducted an audit that found that the program was suffering major cost and schedule overruns, and that Caltrans had not incorporated generally accepted standards for program management. The findings from this audit led to the passage of AB 144 in 2005, which formed the TBPOC. The TBPOC was responsible for program functionality, cost, schedule and overall program oversight for the Toll Bridge Seismic Retrofit Program (TBSRP), which included the East Span Replacement program, and was comprised of the Director of Caltrans, Executive Director of BATA, and Executive Director of CTC.

In addition to the TBPOC, the Program Management Team (PMT) was put in place to provide management and technical support to the TBPOC. The PMT reported to the TBPOC and functioned as a “shadow” board of control, with individuals from Caltrans, BATA and CTC.

Figure 22 illustrates how program governance evolved by phase, from a Caltrans-centric organization initially, to a shared governance structure across the three agencies.

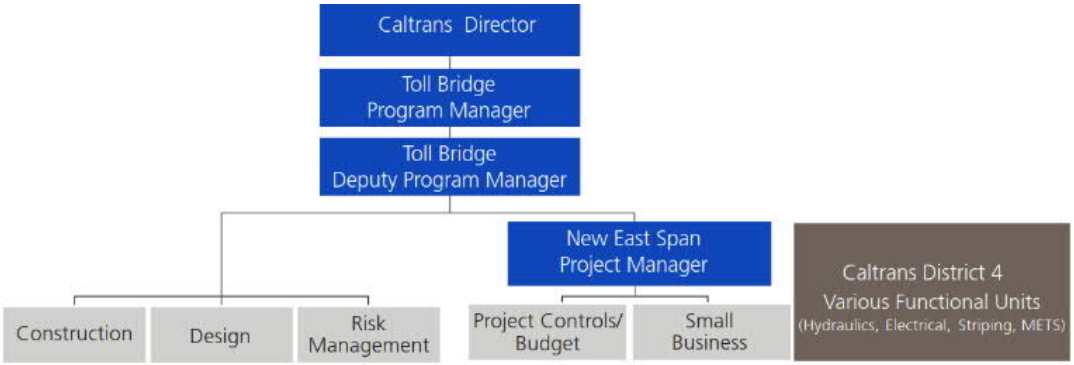
Figure 22: Program Governance by Phase



Source: San Francisco-Oakland Bay Bridge New East Span Program: Lessons Learned Report (May 2014)

The organization of the program delivery team for the East Span replacement is illustrated in Figure 23. The New East Span Program Manager reported to the Toll Bridge Program Manager and Deputy Program Manager, who reported to the PMT and TBPOC. The New East Span Program Manager was responsible for organizing teams, coordinating internal and external communications, and identifying potential problem areas and solutions to address those problems.

Figure 23: East Span Replacement Organization Chart



Source: San Francisco-Oakland Bay Bridge New East Span Program: Lessons Learned Report (May 2014)

Key Decision-Making Mechanisms and Responsibilities

Decision-making became formalized when the TBPOC structure was put in place. The New East Span Project Manager was responsible for dealing with day to day issues, but once an issue began to have significant impacts to the schedule or cost of the program, the he would work with his teams to formally define the issue and corresponding mitigation actions. If the issue exceeded a certain dollar threshold, it would be escalated to the PMT (<$1 million), and if needed, the TBPOC (>$1 million). The Program Manager was responsible for providing information to the TBPOC for decision-making on a monthly basis.

Program Management and Oversight Approach

The TBPOC was an effective governing body because it enhanced accountability, oversight of program finances, and resolution of critical issues related to cost and schedule impacts, as discussed in the San Francisco-Oakland Bay Bridge New East Span Program Lessons Learned Report.

Lessons Learned

Involving multiple agencies with program oversight responsibility for a mega-program of regional significance ensures more unified oversight and representation of all stakeholder interests. A one-agency oversight structure may result in a narrower perspective and consideration with regards to key decision-making.

Another consideration, as identified in the San Francisco-Oakland Bay Bridge New East Span Program Lessons Learned Report, is that governance structures inevitably evolve given the long durations of mega-programs. The program structure should reflect the needs of the program rather than operate within the confines of the existing organizational structure.

FINANCE

Program Finance Mechanisms

The program was initially financed by the state general fund, but once the TPBOC structure was in place after the passage of AB 144, the program was funded entirely by toll revenue generated by BATA. AB 144 identified a comprehensive financial plan for the entire program (i.e., TBSRP), which included the consolidation of all toll revenues collected on state-owned bridges in the San Francisco Bay Area under BATA's jurisdiction. Regional bridge tolls were increased to fund the program.

Challenges with Securing Funding

Although the program suffered increased cost estimates from the start (from $1.3 billion in 1997 to $6.4 billion in 2013), the passage of AB 144 provided a steady stream of funding for the program.

Lessons Learned

A key lesson learned is that delays in resolving design issues for this program significantly added to the final cost of the program.

PROGRAM DELIVERY APPROACH

The East Span Replacement program was delivered through multiple contracts (close to 20 in total). The six main contracts included:

1. Oakland touchdown 1 and 2 contracts
2. Skyway contract
3. SAS contract
4. SAS foundation contract
5. Yerba Buena Island 1 and 2 contracts
6. Yerba Buena Island Detour contract

The program was delivered as a design-bid-build (DBB), following the State of California statutes for awarding the contract to the lowest responsible bidder. Since the bridge was a complex program, the DBB approach enabled the owner to maintain control of the overall design of the bridge and provide appropriate input and guidance during the design and construction phases. The DBB approach allowed greater flexibility with regards to design changes.

Having multiple contracts meant that changes made to the program often affected multiple contracts. In addition, changes to the design were made during construction to accelerate the schedule, resulting in increased costs. This shifted the schedule risk from the contractor to the owner, since in a DBB delivery approach, the owner also assumes any construction and schedule risk resulting from change orders.

Lessons Learned

Selecting a program delivery approach per contract rather than for the program as a whole would have allowed for greater flexibility (in what way?) for the overall program. As well, since contractor selection was based on the lowest responsible bidder, this led to varying performance across contracts.

KEY CHALLENGES AND RESOLUTION MECHANISMS

Several audits were conducted throughout the duration of the program, including:

1. Bureau of State Audits (BSA) 2004-140: Department of Transportation: Various Factors Increased Its Cost Estimates for Toll Bridge Retrofits, and Its Program Management Needs Improving
2. Bureau of State Audits (BSA) 2005-119: San Francisco Bay Bridge Worker Safety: Better Safety Oversight Is Needed to Ensure That Injuries Are Reported Properly and That Safety Issues are Addressed Legislative Analyst's Office: Hard Decisions Before the Legislature: Toll Bridge Seismic Retrofit (2005)
3. The Results Group: Historical Review of San Francisco-Oakland Bay Bridge East Span Seismic Retrofit Cost Increases (2005)
4. California State Auditor 2018-104: Toll Bridge Seismic Retrofit Program: The State Could Save Millions of Dollars Annually by Implementing Lessons Learned

The most relevant findings from the audits are summarized below.

The audit conducted by BSA in 2004 had significant impacts to the program after its findings identified significant cost and schedule overruns and a program management approach that was inadequate for the size and scale of the program. Caltrans did not have a comprehensive and formal risk management approach in place and failed to disclose cost overruns to the California Legislature in a timely manner —they were reported long after they were initially identified.

The most notable outcome from the 2004 BSA audit was the passage of AB 144 (as discussed above), which defined the following operating requirements:

1. Established additional funding that increased the program budget from $2.6 billion (via AB 1171 in 2001) to $5.49 billion (via AB 144) with a $900 million program contingency
2. Established the TBPOC to implement overall program oversight and program control processes for all TBSRP programs
3. Established a comprehensive risk management plan and approach for identifying and quantifying risks, implementing tracked risk response activities, and monitoring and controlling risks throughout the duration of the program.

4. Provided quarterly reporting of program progress and budget and schedule updates to the transportation and fiscal committees of both houses of the Legislature and CTC for the TBSRP.

The audit conducted in 2005 by the Results Group identified the key factors that contributed to cost increases:

1. The initial cost estimate of $80 million that was included in Senate Bill (SB) 60 was for a skyway bridge with a cable suspension span, but the bridge type that was ultimately selected was an asymmetrical SAS with a single tower. This SAS bridge was estimated to cost $2.6 billion in 2001.
2. In 2004, the cost estimate increased to $5.13 billion, which was driven by the following key factors:
    a. Increases to the cost of steel
    b. Increases to costs associated with contractors' time-related overhead and mobilization
    c. Increases to capital outlay support costs
    d. Increases to contingency, based on the complexity of the program and the lack of availability of expertise worldwide for building an SAS bridge.

By 2005, the price estimate had increased again to $6.4 billion, which was the final cost for constructing the new east span.

The California State Auditor conducted an audit in 2018, after completion of the program, which identified key lessons learned that could have resulted in cost savings. Key findings from the report related to the governance structure and program delivery included:

1. The implementation of the TBPOC for program oversight helped manage potential schedule delays and controlled costs
2. The program oversight committee should include individuals from three major agencies and reflect financial interests, but also take into consideration program execution and oversight
3. The risk management plan played a critical role in oversight and preventing program delays
    a. Following the passage of AB 144, a more systematic risk management was incorporated to inform decision-making.

Lessons Learned

A program management approach that takes the size, complexity, and cost of a mega-program into account is critical for ensuring that the program is delivered on schedule and within budget. In addition, legislation to mandate oversight and risk management

should be a requirement for every mega-program to ensure the appropriate controls are in place to deliver it successfully.

RISK MANAGEMENT

Risk Management Approach

At the start of the East Span Replacement program, the delivery team was operating from Caltrans' program development manuals, but the processes (including risk management) proved to be inadequate for the complexity of the issues that arose. There was no systematic risk management approach in place and risk was being managed on an ad hoc basis.

Following the passage of AB 144, a robust risk register was maintained throughout the remaining duration of the program. The risk register functioned as an active management tool; whenever a serious, persistent issue arose with no clear resolution, the management team would conduct a meeting to resolve the issue. Project contingencies were also based in part on the risk register, as risks were identified, regularly assessed and quantified, and incorporated into contingency reserves.

The TBSRP established a risk management team to formalize the approach, consisting of a risk manager and two dedicated risk management specialists and their consultant and construction schedule team. The risk manager worked with staff at all levels to identify risks.

Multidisciplinary task forces were created to assess and resolve major risks in the risk register. The multidisciplinary approach ensured that different perspectives were represented when developing risk mitigation actions.

Lessons Learned

A robust risk management approach needs to be implemented at the start of the program; the East Span Replacement program did not use a risk management approach until mid-way through construction. Had the approach been implemented earlier, some of the issues that the program encountered during its early stages could have been avoided. This applies not only to risk management, but also change management and systems integration. Identifying the types of processes that needed to be in place to deliver the program in advance would have provided a more structured approach for dealing with program issues.

CONCLUSION

The delivery of the Bay Bridge East Span Replacement program initially struggled because of the program's complexity and unique scope. However, once these challenges were recognized, multiple changes were made to ensure program success. The implementation of the TBPOC and PMT provided oversight and a more structured approach for program management and decision-making. The implementation of a systematic risk management approach was essential given the complexity of the

program to ensure risks could be identified and mitigated in a timely and cost-effective manner. These changes highlight how critical it is to consider the needs of the program (and how those needs will change as the program enters various phases) well in advance, and ensure the appropriate processes are in place and formalized so that the program team is well-equipped to deal with challenges as they arise.

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Appendix D: DTX Project Participants

STAKEHOLDERS

TJPA

- Mark Zabaneh, Executive Director
- Meghan Murphy, DTX Program Manager
- Derek Penrice, DTX

Caltrain

- Michelle Bouchard, COO Rail
- John Funghi, Chief Officer, CalMod
- Sebastian Petty, Senior Policy Advisor

California High-Speed Rail Authority (CHSRA)

- Boris Lipkin, CHSRA Northern California Program Director
- Simon Whitehorn, Network Rail
- Bruce Armistead, CHSRA Director of Operations and Maintenance

San Francisco County Transportation Authority (SFCTA)

- Tilly Chang, Executive Director
- Eric Cordoba, Deputy Director for Capital Programs
- Luis Zurinaga, Program Management and Oversight

San Francisco Mayor's Office

- Sean Elsbernd, Chief of Staff
- Paul Supanawich, Transportation Policy Advisor

Metropolitan Transportation Commission (MTC)

- Anne Richman, Director Planning and Allocations
- Andrew Fremier, Deputy Executive Director Operations
- Kenneth Folan, Programming and Allocations
- Peter Lee, Field Operations and Asset Management

Alameda-Contra Costa Transit (AC Transit)

- Michael Hursh, General Manager

San Francisco Planning Department (DCP)

- Doug Johnson, Transportation Planning Manager

EXPERT PANEL

The Expert Panel convened for this effort included the following transportation professionals:

- Ignacio Barandiaran, Principal, Arup, and head of its Transaction Advice Business
- Francisco Fernandez, Project Manager SENER Group
- John Fisher, Northern California District Manager, WSP
- Karen Trapenberg Frick, Associate Professor of City and Regional Planning, UC Berkeley
- Lou Thompson, Thompson Consulting; Associate Administrator, Federal Railroad Administration; World Bank Railways Advisor
- Jose Luis Moscovich, IDS, former Executive Director of SFCTA; former Executive Vice President of Program Finance Advisory Limited (Dar Group); Adjunct Professor-Program Development and Finance-Global Programs Center at Stanford University.
- John Porcari, President, Advisory Services, WSP; former Deputy Secretary and Chief Operating Officer of the United States Department of Transportation (USDOT); former Secretary of the Maryland Department of Transportation. John also served as Interim Executive Director of the Gateway Development Corporation in New York and New Jersey.
- Howard Permut, Permut Consulting; formerly the President of Metro-North Railroad, current member of Metrolinx Capital Oversight Board
- Alvaro Relano, Global Rail Leader, SENER Group
- Geoffrey Yarema, Partner, Nossaman LLP, Founder and former Chair of its Infrastructure Practice Group,

CONSULTANT SUPPORT

- Lillian Hames, WSP
- Doris Lee, WSP
- McKinsey & Company

Appendix E: Key Governance Considerations

Table 1: Key Governance Considerations

PROJECT DEFINITION	ARE THERE ANY RELEVANT CRITERIA TO BE CONSIDERED	TJPA	SFCTA	MTC	CALTRAIN	CHSRA
Financing/Funding	1 – **Funding Plan Development**: designing multibillion-dollar funding plans and successfully securing funds for a program of projects					
	2 – **Revenue Stream Development**: direct control or ability to influence revenue streams that can help fund a large capital program					
	3 – **Financial Plan Development**: structuring financings/debt issuance to address the program's capital needs					
	4 – **Strategic Planning/Service Demand Forecasting**: program-level strategic planning and travel demand forecasting to assess timing and level of service needs					
	5 – **Funding/Liability Firewalling**: ability to firewall the rail program from Salesforce Transit Center (i.e., Phase 1) project liabilities					
Project/Program Delivery (Including Key Processes)	6 - **Project Development and Portfolio Management:** leading and managing programs of multiple projects/mega-projects in complex multi-stakeholder environments to optimize financing, funding capture, program deliverability, and address public benefits of public health, environmental and social equity through urban design, transit oriented development and regional planning.					
	7 – **Procurement**: managing mega-project contracting to deliver projects on time and on budget					
	8 – **Alternative Delivery Methods**: choosing successful project delivery methods and executing effectively					
	9 –**Audit Function**: strong controls/QC functions and internal /external peer review and independent oversight					
	10– **Risk Management**: accurate risk analysis, robust cost estimating, and proactive risk mitigation					
	11 – **Rail operations**: proven track record of running similar local/regional/state rail operations and connectivity to multimodal transportation services					
Long-Term Operations	12 – **Ease of Transition**: ability to structure the migrations of projects for further development/delivery by others and navigate existing statutory authority					

PROJECT DEFINITION	ARE THERE ANY RELEVANT CRITERIA TO BE CONSIDERED	TJPA	SFCTA	MTC	CALTRAIN	CHSRA
Stakeholder management (Board, Agency, Public, Political)	13 – **Stakeholder Management/Engagement**: meaningful, effective and proactive engagement of the public and key stakeholders, rallying political and public support, developing strong relationships with funders and external oversight bodies, mobilizing multiple agencies to action, and resolving conflicts					
Culture	14 – **Transparency**: organizational culture that fosters proactive information sharing and collaborative problem-solving					
	15 – **Innovation and Change**: culture that fosters innovation, change and learning at all levels, champions best-practices					
	16 – **Capacity**: availability of management, staff and board members to actively engage and participate in substantive and effective decision-making, oversight and advocacy					

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