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Learning from California: Lessons Drawn from California High-Speed Rail for Other Large Infrastructure Projects

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Purpose

The purpose of this paper is to provide a practitioner's perspective on the most important lessons from California's high-speed rail program for the next generation of mega projects. This is neither a criticism of the project nor a defense of every decision that has been made on it. Instead, this paper highlights those areas that are most common across large projects where the California high-speed rail project's experience can be instructive.

Introduction

The California High-Speed Rail (HSR) program is one of the most complex and ambitious infrastructure undertakings in the United States. Given the significant progress achieved across the state (although substantial work remains), this is an opportune moment to assess the California HSR project and consider the lessons its development offers for other large-scale infrastructure initiatives. While the scale of the HSR program makes it stand out, the challenges, decisions (and their ramifications), and experiences of the program over the last 20+ years are common with many other significant endeavors.

The lessons included in this paper are drawn from my personal experience working on the program over the last 15 years. Between 2018 and 2025, I was the Northern California Regional Director for the California High-Speed Rail Authority (CHSRA) leading development for 160 miles of the system between San Francisco and Merced Counties. In this role I was involved with components of the system at all stages of project development from early-stage planning (such as the redevelopment of the Diridon Station) to completing environmental clearance and on through construction (Caltrain Electrification) and construction closeout and operations (Salesforce Transit Center). Prior to that, I was Deputy Director of Strategic Planning overseeing the development of the agency's Business Plans, Funding Plans, and implementation/commercial strategies.

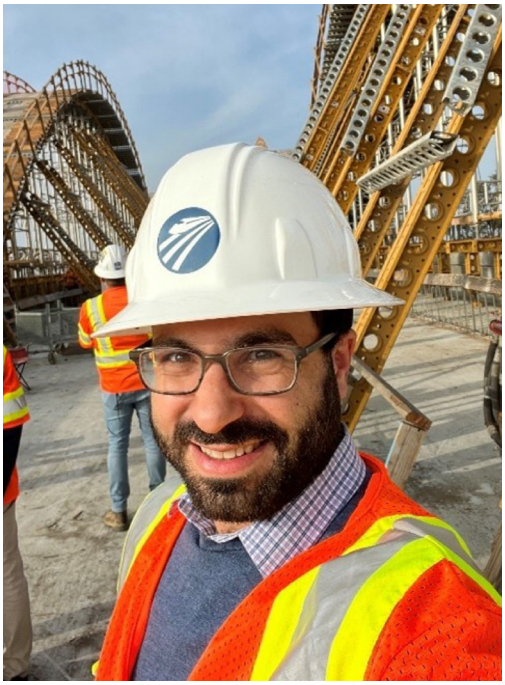

Figure 1. The Author on top of the Cedar Viaduct in Fresno, CA

Brief History of the California High-Speed Rail Project

The idea for California's high-speed rail system started when the French high-speed rail line between Paris and Lyon was opened in the early 1980s. After some preliminary feasibility assessments, the CHSRA was created in 1996 and charged with planning, constructing, and operating the high-speed rail system. The CHSRA planned out a route for the system and made a series of key decisions (such as what technology to use) before putting its plans before the voters of California for approval in 2008 through Proposition 1A. The voters approved the project with 53% of the vote, allocated $9 billion through general obligation bonds to begin development and construction, and included a series of requirements for the system's design and how those funds would be used (more on this later in the paper). Construction broke ground in the Central Valley in 2015.

The plan that the voters approved included a 500-mile Phase 1 from San Francisco to Los Angeles and Anaheim and a 300-mile Phase 2 with extension to San Diego and Sacramento. The system is using steel wheel on steel rail technology and is being designed with maximum operating speeds up to 220 miles per hour.

Figure 2. Statewide High-Speed Rail System Plan Approved by California Voters in 2008

Current Status of the California High-Speed Rail Project (as of Fall 2025)

The table and map below summarize the current status of the project. The full alignment between San Francisco and Los Angeles is now environmentally cleared. Construction is underway on 119 miles of civil works in the Central Valley with 22 miles now complete. The Caltrain corridor has been electrified and key grade separations and stations have been built. The procurement for the first batch of trainsets is underway and tracks are expected to start to be laid in the Central Valley in 2026.

To put the construction progress in context, the first stretch in the Central Valley is the longest new rail line being built in the United States since the Ford Model T was the best-selling car. That construction has required the acquisition of almost 2,300 parcels of property and the relocation of over 1,800 different utilities—a project of unmatched scale in the country's recent history.

Figure 3. Current Status of the Phase 1 HSR System

Phase	Miles	Segment
Construction Complete – Civil Works	22	Construction Package 4 (Central Valley)
Construction Complete – Electrification	51	Caltrain Electrification (San Francisco to San Jose)
Construction Complete – Stations	N/A	Salesforce Transit Center (San Francisco) and ARTIC Train Station (Anaheim)
Construction Complete – Grade Separations	N/A	Rosecrans/Marquardt (Santa Fe Springs) and 25th Avenue (San Mateo)
Construction Ongoing	97	Central Valley
Environmental Clearance Complete	463	San Francisco to Los Angeles
Environmental Clearance Ongoing	31	Los Angeles to Anaheim

Key Lessons from California High-Speed Rail for Other Large Infrastructure Programs

Experience from the California HSR program points towards six key lessons that are going to be broadly applicable to many other large infrastructure programs:

1. **Manage the Brand**
   Large infrastructure projects are inherently visible endeavors that will be in the public eye and discourse. They often also rely on consistent political champions that help clear roadblocks and help projects advance. Managing the brand means taking active steps to lay out the vision, engage with communities, manage risks, and nurture the relationships with political champions that can have outsized influence on the project's ability to move forward.

2. **Funding Drives Outcomes**
   Decisions on funding, more than almost anything else, will dictate the outcomes of what will actually happen on the ground. However, the uncertainty of funding for major projects adds to project complexity and makes every decision include a layer of analysis on the tradeoffs of how to allocate limited resources. Additionally, the pursuit of new funding sources may lead to more costly decisions as projects avoid controversial choices that could reduce costs but risk losing the support needed to gain new funding. Finally, project development sequencing and activities need to consider more than just project cashflow in deciding what steps get advanced in what order.

3. **Environmental Clearance Is Not Planning**
   While environmental clearance for a project is an important step toward project definition and being able to get to construction in a timely manner, it is not how you plan projects. Proper planning work—such as developing a business case, setting a vision, defining key aspects of the project, and looking at alternatives—will reduce the risk that the environmental clearance process gets stretched out longer (and costs more) than is necessary. During all of those processes, it is also important to articulate where and how the project will seek input to give interested parties the venues for engagement.

4. **Organisation vor Elektronik vor Beton (Organization before Electronics before Concrete)**
   Based on the German rail planning axiom about how to upgrade existing rail lines, "organization before electronics before concrete" means that reaching agreements or setting out organizational terms will be orders of magnitude less expensive than upgrading electronics (e.g., signaling systems), which in turn will be orders of magnitude less expensive than pouring concrete (i.e., building new civil infrastructure). However, the importance of getting the governance and organization right goes beyond just the cases of upgrading existing rail lines. Governance, decision-making structures, oversight, and "superpowers" come early in projects but have lasting consequences for how projects advance.

5. **Consider Project Segments and Phasing (at the Right Time)**
   Every large project will face the question of how to break the project apart (for environmental clearance, for pre-construction activities, for actual construction packaging and more). While these are decisions that will have project-specific contexts and no universal single answer, a key lesson from the HSR project is the importance of making these decisions at the right time and aligned with the agency's ability to manage the scopes of work that it is undertaking.

6. **Ballot Measures Set Identity**
   Ballot measures will enshrine commitments into law that are very difficult to change. This can both create discipline and identify for a project (and the outcomes it is trying to achieve) but might also come with unintended consequences or unknown tradeoffs. This means that in setting out what goes into a ballot measure it's critical to consider the long-term project effects while also solving for near-term needs (for example, of gaining enough support for the ballot measure to be approved).

Lesson 1: Manage the Brand

Why this matters:

The history of large projects is that when their brand loses appeal they risk being cancelled or curtailed. California's HSR project has avoided that fate.

The Merriam-Webster Dictionary defines "brand" as a "public image, reputation, or identity."[1] Large public works projects are of immense public interest and, just as anything else that gets a lot of attention, over time they come to be associated with a brand. That brand is going to be made up of the reasons that there has been a desire to pursue the project in the first place but also a collection of all the other views that have been expressed about that project. By means of an example, below are two word clouds produced by ChatGPT summarizing the vision for California's High-Speed Rail project and the criticisms of the project (which together are a reasonable summation of major parts of its brand in the public atmosphere):

1 https://www.merriam-webster.com/dictionary/brand

Figure 4. ChatGPT-Produced Word Clouds of the Vision and Criticisms of California's High-Speed Rail Program[2]

2 Word clouds created in April 2025 utilizing ChatGPT-4o with the following queries: "create a word cloud for the vision for california's high-speed rail project keeping phrases together", "create a word cloud out of these, keep phrases together and remove underscores", and "create a word cloud of the negative views of california's high-speed rail project. Use red, brown, and orange colors".

Committed Political Champions are Essential

The reason that it's important for public works projects to continuously consider and manage their brands is that they are inherently dependent on the support of political champions to be able to garner the resources and buy-in needed to move forward. The examples of large projects that lost political support and were either cancelled or delayed by a generation or more are numerous, but a few examples are useful to highlight (this is meant as illustrative, not comprehensive):

Table 1. Select List of Major Projects that Lost Support and Faced Setbacks

Project	Objective	Status
Access to the Region's Core (ARC)	Construct a second set of rail tunnels across the Hudson River between New York and New Jersey.	Project was cancelled in 2010 after beginning early works construction activities. Similar effort now ongoing through the Gateway Project.
Ohio 3-C Project	Improve intercity rail service between Ohio's three largest cities (Cleveland, Columbus,and Cincinnati).	Rejected a $400 million grant award from the federal government in 2011. Recently received a $500,000 grant for a new round of planning.
Columbia River Crossing	Construct bridge replacement (and light rail line extension) across the Columbia River between Oregon and Washington.	Cancelled after opposition in the Washington State Senate in 2013. Replaced with new planning through the Interstate Bridge Replacement Program.
Cincinnati Subway	Build new subway system for the City of Cincinnati.	After constructing two miles of subway tunnels, the project was cancelled when political winds changed in the 1920s, with the tunnels never seeing tracks or trains.

By comparison, the California HSR program has enjoyed continuous support from the last five governors of California (two republicans and three democrats). Similarly, the voters of California have maintained their support for the project since the passage of Proposition 1A in 2008, with most recent polling from February 2025 having support at 54% (compared to 53% when Proposition 1A was approved)[3]. This support has both been essential for the program to be able to advance but also not an accident or fluke. The agency has taken proactive steps to develop a compelling vision, communicate its progress, and address the challenges that the project has faced.

The Brand Will be Strongest at the Vision Stage

Another commonality for large projects is that the brand of the project will be strongest at the vision stage (more of the first word cloud above and less of the second one). At that point, the project has typically laid out what it is trying to achieve and what problem it is trying to solve but has yet to tackle the challenges of implementation or the inherent tradeoffs that can lead to controversy. During this stage of the project's development, it is critical to consider the long-term implications of the promises being made as overpromising what's feasible will undoubtedly lead to disappointment down the road. In the same vein, it's important to set realistic expectations and be transparent about what you know and don't know. Project definition will come over time, but if the ambition that is laid out during the vision stage is unachievable then those broken promises will follow the project throughout its development.

3 Emerson College Polling (February 2025): https://emersoncollegepolling.com/february-2025-california-poll-kamala-harris-emerges-as-democratic-frontrunner-for-governor/

Importance of Engagement and Risk Management

On a practical level, maintaining the brand also includes the need for ongoing engagement with the community or communities that the project will serve and that engagement needs to be two-way (both sharing information and receiving feedback), local (it's not enough to just put something on a website), and consistent. With a large project, it can feel unresponsive and out of touch if there is not a concerted effort to bring people along and meet them where they are.

Finally, the management of risks on a mega project needs to be a continuous process and almost part of the DNA for an organization that is charged with the project's execution. Large public works will always face significant risks and when those risks are not well understood and managed, they will manifest in ways that will have lasting impacts on the project's credibility (and of course will have associated cost and schedule effects as well). The public does not expect a mega project to not face issues but does expect transparency and honesty in how those risks are being addressed.

Lesson 2: Funding Drives Outcomes

Why this matters:

Funding decisions, more than any other kind of decision, dictate outcomes on projects so understanding that relationship offers valuable insight into what happens on the ground.

The decisions on how we fund projects have the most weight in dictating what will get built and in what order. Whether through legislative appropriations, grant agreements, voter initiatives, or other means, funding is typically provided for the purpose of achieving specific outcomes (such as building all or part of a project) so the choices that are made in asking and receiving funding have an outsized effect on actual project outcomes.

Projects Align to the Funding Sources They Receive

For the California HSR project, the key set of funding decisions were made when the CHSRA applied for federal funding in 2009. The CHSRA submitted separate funding applications for Northern California, the Central Valley, and Southern California. The federal government chose to fund the Central Valley application for construction and the other two for environmental clearance. That fateful decision has had a lasting effect on every choice since that time on how to advance the program.

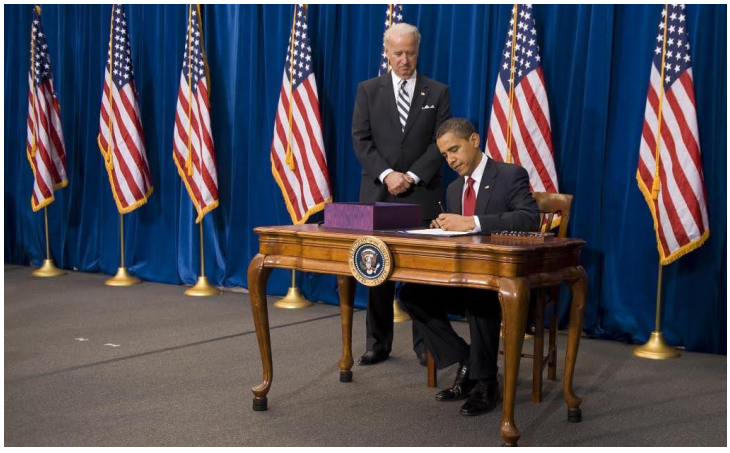

Figure 5. The Federal Government's Decision to fund construction in the Central Valley through the American Recovery and Reinvestment Act (being signed by President Obama in the picture) drove project outcomes

By choosing the Central Valley (and this decision remains a hot topic of conversation and the source of substantial controversy), the federal government answered the question of "Where should California HSR start construction?" and created the new

question of "How do we maximize the benefit of the investment that has been made in the Central Valley?" The particular difficulty with this decision is that while there were (and are) good reasons to have chosen the Central Valley (prime amongst them being the need to have a long enough and straight enough test track to prove the safety case for trains running at 220mph), connecting the Central Valley to the major population centers in Los Angeles and the Bay Area remains a difficult proposition. As CHSRA laid out in its 2024 Business Plan, there are benefits to rail ridership from an improved service in the Central Valley, but those benefits are dwarfed by the ridership and economic potential of the system when it connects more of the state together.[4]

Uncertainty of Funding is a Major Contributor to Project Complexity

Another way that funding impacts outcomes on the ground is that the uncertainty of funding creates an added layer of complexity that project sponsors have to wrestle with. Every choice to move part of the project forward has to prove that it's the best use of a limited amount of resources and every prioritization exercise involves finding the balance between the top priority and the other priorities that the project sponsor has.

The dynamic that this creates is that there are differing views between those that see the current funding envelope as the only funding that can be counted on (and thus every investment decision should be about maximizing the benefit of the currently available funding) versus those that are comfortable counting on future funding to come in so that current funding can be used to make investments that will require additional funding to provide benefits. In the case of California's HSR project, these sorts of differences in perspective were often found in discussions between the many entities that had to get aligned for the project to move forward with broad buy-in (i.e., CHSRA itself, the Legislature, the Department of Finance, and/or the Governor's office).

The complexity of getting alignment on those key investment decisions means that a lot of time gets spent on the forecasts of project cashflow and funding needs going out several years into the future. However, both the cost and funding projections would often face significant uncertainty, so a forecast going out several years was likely to have a substantial margin of error attached to it. By focusing exceedingly on those forecasts, the project sometimes missed opportunities to make strategic project development decisions such as starting on long-lead time, relatively low dollar value items that would produce durable products and reduce the timelines for delivery once future phases of work were funded (a prime example of this would be geotechnical investigations in areas with planned tunnels and/or major structures).

4 2024 Business Plan (https://hsr.ca.gov/about/high-speed-rail-business-plans/2024-business-plan/)

Cost Containment vs. the Pursuit of Funding

While it would seem that decisions that drive costs would be independent of decisions on funding, they are actually intimately related. Table 2 shows the funding milestones for the California HSR program since voters approved Proposition 1A in 2008. While each of those funding decisions has a story behind it, the key point is that since the project's initial approval, there has been a funding milestone every few years. Since many of these decisions involved multi-year deliberation and negotiation processes, this means that at almost every point in the project's history, it has been in the process of pursuing additional funding to be able to build more of the system. This makes sense since the project has never been fully funded.

Table 2. Funding Milestones for California HSR since 2008

Year	Funding Milestone
2008	Proposition 1A Approved
2009/2010	Federal Funding (ARRA and FY '10)
2012	Appropriation to begin construction
2014	Cap and Trade allocation
2017	Cap and Trade extended to 2030
2022	Appropriation of remaining Proposition 1A funds
2022 – 2024	New Federal Funding (IIJA)
2025	Cap and Trade extended to 2045

However, the pursuit of funding also had ramifications for efforts to contain costs. For example, if an alignment choice would have more impacts to a community and risk losing the support needed to receive the next round of funding then a more expensive (and less impactful) alignment might have been chosen. Of course there are other good reasons to select alignments that might cost more but reduce project impacts (in fact, often this is required by laws like the California Environmental Quality Act (CEQA)) but the overlay of constantly having to pursue new funding meant that the balance of those interests might be viewed differently than it would be in a fully-funded project that was only focused on delivering to an approved project budget.

Lesson 3: Environmental Clearance Is Not Planning

For major projects, environmental clearance plays an outsized role in the project development process. Completing environmental clearance—by going through the National Environmental Policy Act (NEPA) and CEQA (in California only) processes—means that a project that has achieved substantial project definition (i.e., it has laid out what the project will be) has had meaningful engagement and feedback with the community and has significantly reduced the schedule uncertainty of how quickly construction could begin. However, the environmental clearance process is not well-suited to planning projects.

Why this matters:

The goal of achieving environmental clearance can become the lens through which projects are planned and developed but that can lead to suboptimal outcomes.

By means of an example, the CHSRA began its environmental clearance effort for the segment between San Jose and Merced in 2009, right after voters approved the system through Proposition 1A. When I was appointed as the Northern California Regional Director in 2018, the CHSRA had, over nine years, gone through a serial process of looking at alternatives creating an "alternatives do-loop" (see Figure 6).

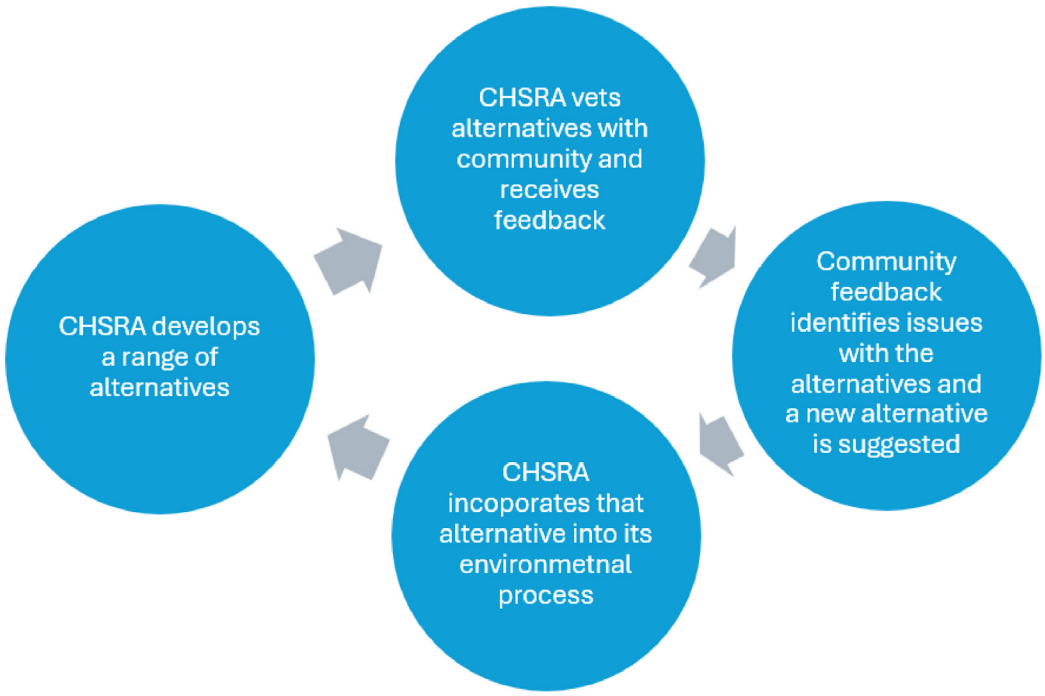

Figure 6. "Alternatives Do-loop" that the CHSRA had gone through between 2009 and 2018 for the San Jose to Merced Project Section

Each time that CHSRA would develop a range of alternatives, the community, stakeholders, and/or project partners, would identify a new alternative that they would ask CHSRA to study. During that time, CHSRA would generally add that alternative to its environmental process but require it to be developed and studied at the same level of detail as the other alternatives it had already reviewed. This process would take a year or more during which the flaws of the new alternative would be identified, and another new alternative would be suggested that would appear to solve those flaws (and the process would repeat again).

Getting out of the alternatives do-loop was a top priority for me when I was appointed as the Northern California Regional Director so that we could get the environmental clearance process moving. After getting buy-in on the range of alternatives we were studying at the time, we quickly moved to identify a Preferred Alternative (with significant community input) in 2019, issued the Draft Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) in 2020, and finalized the environmental document, leading to the CHSRA Board of Directors approving the project section in 2022.

While those nine years of alternatives analysis were an important foundation for our ability to ultimately complete the environmental clearance process, the same outcome could have been achieved in less time and at much lower cost if the alternatives were studied through a planning process instead of an environmental process. The vetting of alignment options to find their flaws

does not require the same level of engineering or environmental analysis as incorporating an alternative into an environmental document (especially for a large and complicated document like the 88-mile San Jose to Merced project section). Proper planning-level analysis would have likely reached the same conclusions but at a fraction of the time and cost that CHSRA incurred.

Developing a Business Case

The other key distinction between planning and environmental clearance is that planning also gives the project sponsor the space to develop the business case for a project that can answer some of the highest-level questions that projects have to address. That way, the business case can form the background and basis for the more detailed analysis that is undertaken through environmental clearance. The types of questions that can (and often should) be addressed in a business case include:

- What are the goals/benefits you are aiming to provide?
- What will be the "product"?
- What is the strategy for program development and delivery?
- What are the costs and funding options?
- What are the risks?

By answering these questions, defining the overall structure of the program, and getting buy-in on those key elements, the business case takes the pressure off the environmental document to answer questions that environmental analysis is not equipped to answer. The development of the business case also provides the project sponsor with an opportunity to define and articulate the process for how input will be sought and incorporated into some of the key decisions driving the program.

Finally, the business case should be adjusted over time as new information comes to light and decisions are made. However, the CHSRA requirement of updating its business plan every two years is too frequent as it creates a continuous cycle of updates that take substantial time and effort to put together (typically around 14 months for the CHSRA business plan) and where outcomes of the previous plan are yet to fully materialize.

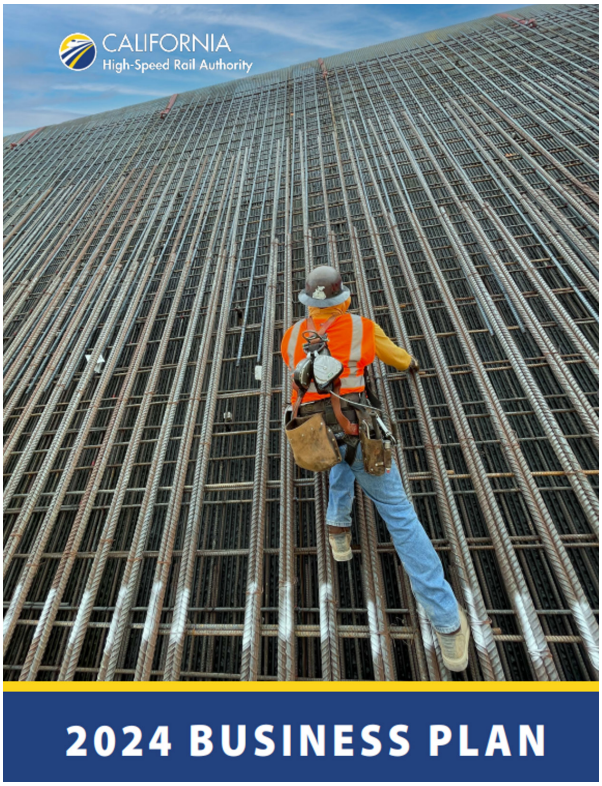

Figure 7. CHSRA develops and updates its business plan every two years - 2024 was the latest update

Lesson 4: Organisation vor Elektronik vor Beton (Organization before Electronics before Concrete)

Why this matters:

Decisions on what needs to be built and how the organization building should be organized and governed will materially impact cost, schedule, and project outcomes.

The term "Organization vor Elektronik vor Beton" originates in German rail planning and was popularized in the English-speaking world by Alon Levy.[5] The basic principle is that optimizing existing systems and operations is a lot less expensive than investing in new technology (such as signaling systems), which is a lot less expensive than large-scale infrastructure projects that require new civil works. This very much applies in the context of planned upgrades along existing rail corridors on the California HSR system but, equally as importantly, highlights the need to get the governance and organization right to be able to deliver these large programs.

Caltrain Corridor

When CHSRA first began looking at routes between San Francisco and San Jose, it proposed to four-track and grade separate the existing Caltrain line (which was primarily a two-track railroad with over 40 at-grade crossings). However, that corridor had been built while Abraham Lincoln was president and the communities on the San Francisco Peninsula had grown up around it. Widening and grade separating the entire corridor meant huge impacts to downtown after downtown in communities along the Peninsula and led to significant community opposition to the proposal.

Figure 8. Electrified service on the Caltrain corridor started in 2024

5 First used on his blog in 2011: https://pedestrianobservations.com/2011/05/20/philadelphia-link-or-organization-before-concrete

Ultimately, the dialogue with the community led to the adoption of the Blended System, where CHSRA would invest in upgrading and electrifying the existing rail corridor and both services (Caltrain and CHSRA) would run on the same infrastructure. This agreement significantly reduced the impacts to the surrounding communities and resulted in a solution with a lot more organization and electronics than concrete, thus reducing costs by several billion dollars.

Importance of Governance and Organization

The governance and organization for an entity aiming to develop and deliver a megaproject is of utmost importance. If the governance is not setup effectively then efficient delivery of the project or program can be significantly hampered. Similarly, there has been a lot written on the issue of insufficient organizational capacity for large projects and the risk that poses to cost and schedule. [6]

For many large projects, these questions of governance, decision-making structures, oversight, and the "superpowers" that the agency is given will come early in its development. For example, this might be part of the authorizing legislation that sets up the entity or a foundational agreement for something like a Joint Powers Authority. What that means is that it's important to consider the full lifecycle of what the agency will be asked to do in order to make sure that it's given the right tools for the job.

In the case of CHSRA, many of these decisions were made when the Legislature first created the agency in 1996 through Senate Bill 1420.[7] Table 3 shows that CHSRA was given specific broad authorities in areas focused on contracting and procurement, joint development, and fare setting but was not given any unique authorities on many of the critical elements needed to deliver a megaproject. In practice, what this meant was CHSRA could issue any contract type it wanted to (while other agencies were limited in their procurement flexibilities), but the high-speed rail project was treated just as any other project in the many areas where specific authorities could have allowed the agency to deliver the project more efficiently. There are current discussions in

Table 3. CHSRA "Superpowers" relative to the full lifecycle of its mandate

"Superpowers"	California High-Speed Rail Authority
Procurement	Broad authorities
Human Resources/ Hiring	Extra political appointees
Funding/ Revenue	Continuous Appropriation
Environmental and Permitting	None
Third-Party Agreements (utilities, cities, etc.)	None
Eminent Domain	None (less than Caltrans)
Railroad Agreements	None
Constructions	None
Regulatory	None
Joint Development	Broad authorities
Fare Setting	Broad authorities

6 Examples include the Transit Costs Project (https://transitcosts.com/wp-content/uploads/TCP_Executive_Summary.pdf)

7 http://leginfo.ca.gov/pub/95-96/bill/sen/sb_1401-1450/sb_1420_bill_960924_chaptered.html

the Legislature to rectify some of this with regard to third-party agreements, but this is coming almost 30 years after the agency was founded and over 10 years after construction began.

During the course of its history, the CHSRA organization has been a dynamic and growing one. Starting with just a handful of staff when the voters approved Proposition 1A in 2008 and growing to almost 500 employees as of 2025 (see Figure 9). While this sort of growth is almost unmatched in any other part of California state government, it also offers important lessons for others looking to take on a large project.

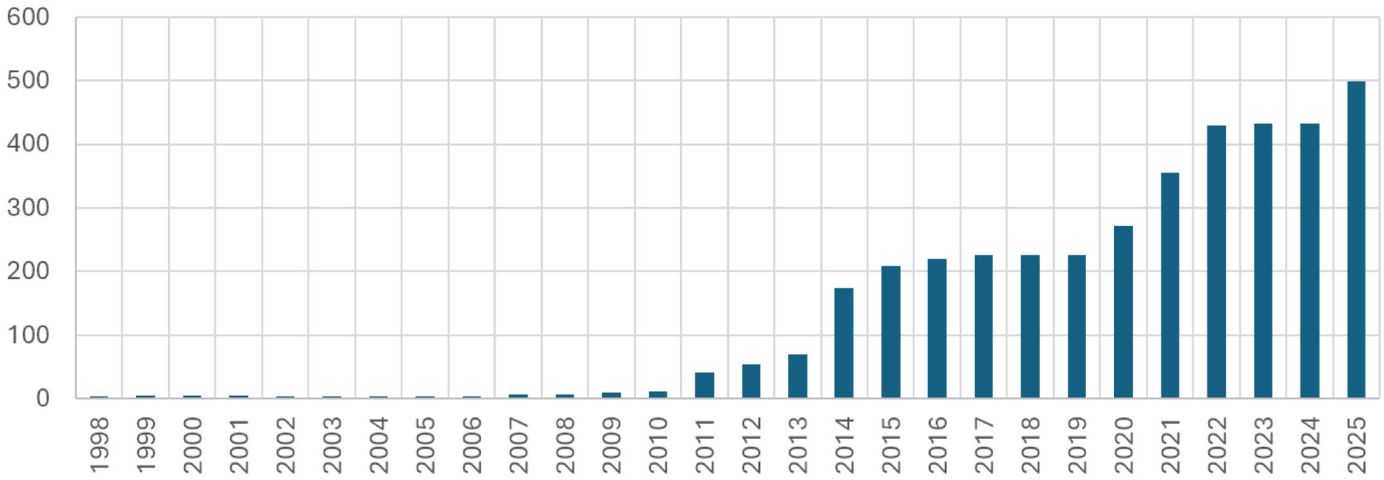

Figure 9. CHSRA Agency Full-Time Positions Over Time

First, building the organization needs to be a function within the organization and it requires active attention from management and leadership. There were many times that new positions would be authorized in bunches, but the organization did not have enough human resources or other personnel to quickly recruit and onboard that many new hires while maintaining current operations. This led to challenges in filling those positions in a timely manner.

Second, new positions would often only be approved after a new phase or scope of work would begin, not beforehand. This meant that CHSRA was oftentimes tasked with building out the management and processes to oversee the work during key project development phases instead of ahead of them. In the interim, CHSRA would often rely on consultants to fill in those organizational gaps so that work could commence or proceed.

Finally, megaprojects require specialized resources and skillsets that will typically be unlike any other parts of (in the case of CHSRA) state government or other departments of the organization. Existing budgeting and hiring processes, civil service classifications, and pay structures may need to be adjusted to meet the needs of the megaproject management and oversight.

Lesson 5: Consider Project Segments and Phasing (at the Right Time)

There is an inherent contradiction in megaprojects where their vision is best articulated as one big project that achieves significant objectives while the reality of their scale means that they will, almost always, need to be broken up into phases or segments at some point in their development and delivery. The key questions for that are when during the project development process does the project get broken up (see Figure 10) and how does that actually get operationalized. Here too, the CHSRA experience can offer valuable lessons learned.

Why this matters:

Every large project will at some point need to be broken up and managed in pieces. How (and when) to do that will have big impacts on the effectiveness of project delivery.

Figure 10. 2020 Business Plan Summary of Project Sequencing Reforms

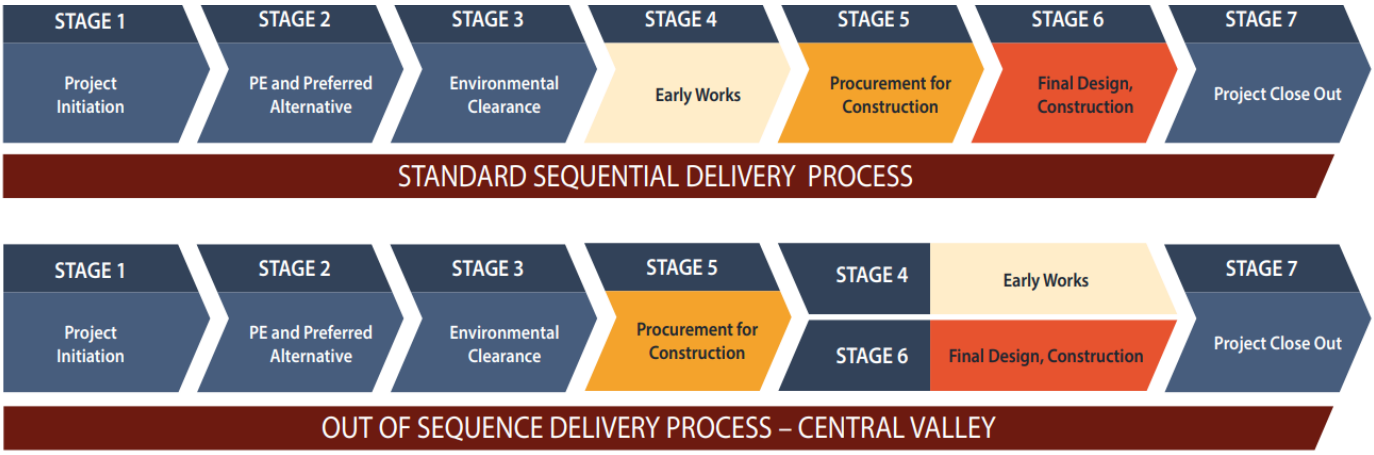

Figure 11. 2020 Business Plan Summary of Project Sequencing Reforms

Pre-Construction Activities Can Form the Critical Path

In its 2020 Business Plan, CHSRA described a series of reforms it was undertaking at the time for its future work based on the painful experience of how it had started construction in the Central Valley.[8]

The most important reforms were focused on ensuring that sufficient pre-construction work (such as right-of-way acquisition and utility relocation) was completed before construction would begin. Those pre-construction activities included actions by external parties that CHSRA could not control but that had profound effects on CHSRA's contractors' ability to do their work. This experience offers several valuable insights focused on pre-construction activities:

1. Pre-construction activities involve outside parties such as property owners, local courts (who make decisions in the case of eminent domain), utility owners, and local jurisdictions. Each of those entities will have its own goals and processes, which may not align with the timelines that the project would like to operate under.

2. Advancing design and executing master agreements early is key. Between 2016 and 2021, as CHSRA was advancing designs and finalizing agreements with utility owners in the Central Valley, the Authority acquired over 1,000 parcels of property. However, as designs were being finalized during that process, the number of parcels that the agency had to acquire rose from 1,450 to 2,290.[9] This means that the number of outstanding ROW parcels only decreased from 705 to 519. If those agreements and designs were in place earlier, then the ROW program would have been able to sequence acquisitions faster (leading to fewer delays in construction).

3. Complicated locations (for example where multiple utilities intersect) require specialized attention. CHSRA had to relocate over 1,800 utilities for its first 119 miles of construction. These ranged from simple utility poles that had to be moved to much more complex situations. One such example was described by the California High-Speed Rail Office of Inspector General in their report on challenges in pre-construction activities.[10]

In this location, the Northern Kern Water District's canal goes under the BNSF railroad. The CHSRA guideway is following the BNSF line requiring relocation of the canal under both the guideway and the existing rail line. However, the property rights between these two organizations have been a subject of dispute for close to 100 years, so any change in the status quo required new arrangement, and CHSRA found itself stuck navigating that historic dispute. This led to this last 400-foot stretch of guideway being unfinished for a prolonged period of time while the rest of the 22.5-mile construction package was fully complete.

8 2020 Business Plan (https://hsr.ca.gov/wp-content/uploads/2021/04/2020_Business_Plan.pdf) Chapter 6

9 2016 Business Plan (https://www.hsr.ca.gov/wp-content/uploads/docs/about/business_plans/2016_BusinessPlan.pdf) Page 22 and 2020 Business Plan (https://hsr.ca.gov/wp-content/uploads/2021/04/2020_Business_Plan.pdf) Page 38.

10 Pre-Construction Activities for the Merced and Bakersfield Extensions (https://hsr.ca.gov/wp-content/uploads/2025/02/Early-Works-Engagement-FINAL-A11Y.pdf) Page 6.

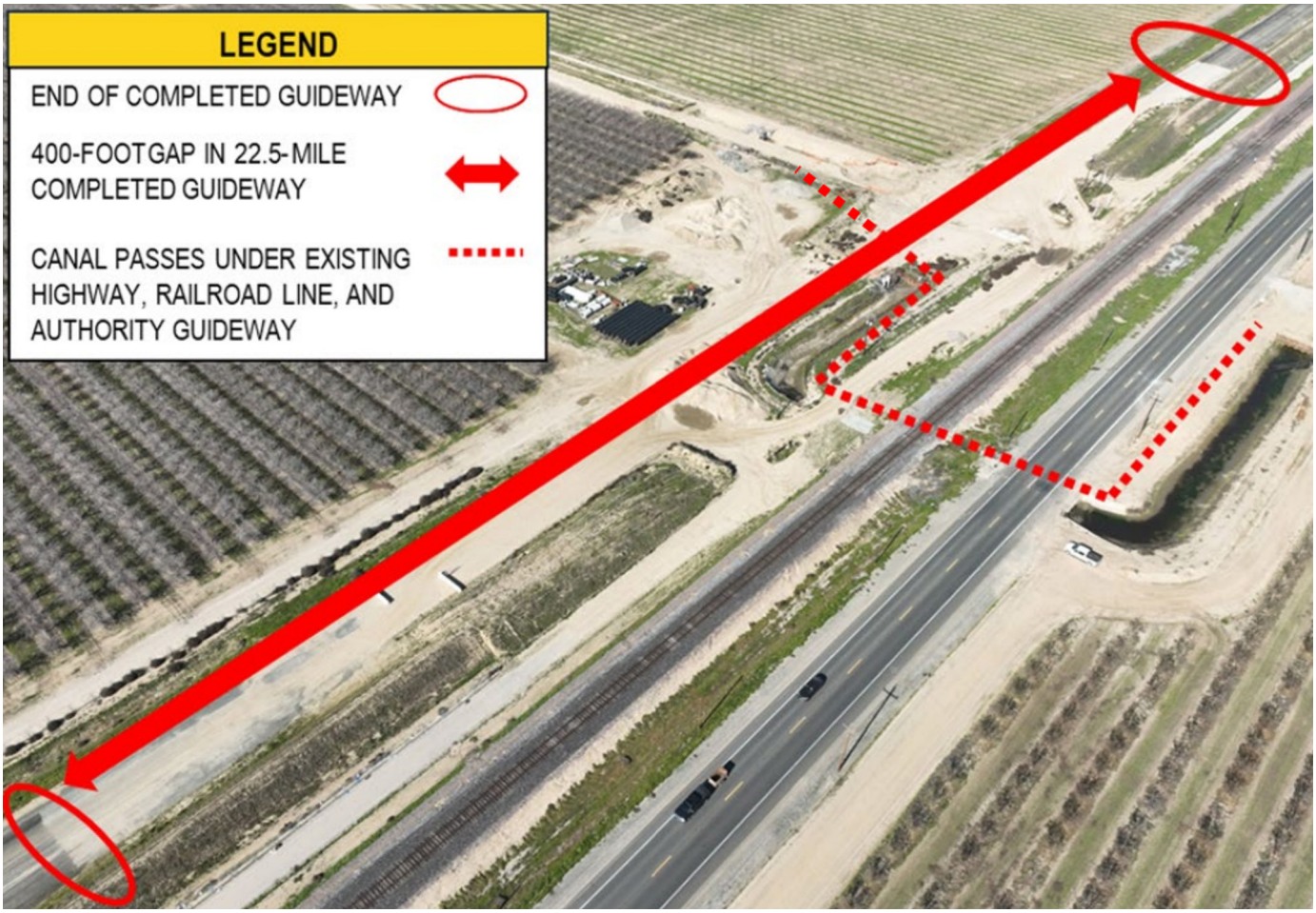

Figure 12. CA HSR OIG Report Showing the Area of Conflict that CHSRA had to Address to Proceed to Construction

4. To manage pre-construction activities and negotiations effectively, it's important to identify key staff leads and develop clear status reporting and escalation protocols. Since pre-construction activities all deal with outside parties, having clarity on what the roles and responsibilities in those engagements will look like is important for being able to navigate the nuances and each partner organization. While the leadership roles for these negotiations may be distributed, it's important to maintain centralized reporting and management to ensure that issues could be tracked, elevated, and addressed in a timely manner.

5. Beware of starting construction too soon. The biggest lesson from CHSRA's construction boils down to the fact that the construction in the Central Valley started before sufficient pre-construction activities were complete (due to stringent funding deadlines). Making sure that pre-construction work is well advanced before beginning construction is key to reducing risk of delay and claims.

Construction Contracting Approaches to Minimize Risks

Similarly, few large projects will be able to only have one construction contract for all or most of the project's scope. When breaking a project apart, there will always be questions of both horizontal (geographic) and vertical (types of scope) integration. The answers to those questions will be unique to a given project's circumstances, but some general best practices will apply:

1. There are practical limits to the size of a contract that can receive meaningful market competition. Contracts that are too big will run into bonding capacity limitations.

2. It can be beneficial to include multiple scope components together in one package if they have significant interfaces that need to be managed and that responsibility can be transferred to the contractor who will be better able to manage it.

3. At the same time, some components (such as tunnels) require specialized expertise and will typically be procured separately.

4. There will be elements (such as civil works) that may be more amenable to the contractor being responsible for the design (through a design-build or progressive design-build contract) while with others (such as stations)[11], the owner will generally want to maintain control over the design (through a design-bid-build or construction manager/general contractor or construction manager at-risk procurement).

5. No matter how the scope is divided up, the owner will ultimately be responsible for the interface points and conflicts between its contractors. This creates a tradeoff between having more contracts where the contractors can be more specialized but where the owner has to manage more project interfaces or fewer contracts where teams or consortia have to work together but some disciplines on a big team may be stronger than others.

These decisions will require careful consideration on a case-by-case basis tied to a project's circumstances. The important thing is understanding the owner organization's priorities and capabilities and the tradeoffs inherent in these decisions and then structuring the contracting approach to match those priorities and capabilities.

11 There are examples of stations that were completed under a design-build contract, but many of them end up having either user experience or operational challenges that could have been better addressed if the owner had taken more ownership of the design.

Lesson 6: Ballot Measures Set Identity

Why this matters:

Ballot measures become foundational cornerstones for projects that have gone to voters for approval.

In the United States, most large projects will at some point seek voter approval either to move forward and/or to secure a key source of funding. These moments will have profound implications for how the project will progress because ballot measures enshrine commitments into law in ways that are very difficult to change. A ballot measure can create discipline and identity for the long term, but it might also have unanticipated side effects or unknown tradeoffs.

For the California HSR project, the main example of this are the travel time requirements that were included in Proposition 1A. Section 2704.09 of the bond measure states that the system "shall be designed to achieve… maximum nonstop service travel times for each corridor that shall not exceed the following… San Francisco to Los Angeles Union Station: two hours, 40 minutes." At the time that this was put before the voters, only very basic engineering had been done and preferred routes and alignments were not going to be identified for years to come—but this promise to voters would have profound effects down the line.

The drafters would argue that this provision ensured that funding from the bond measure would only go to developing a true high-speed rail system and would create the discipline for CHSRA to maintain the vision that the voters had approved. At the same time, this one requirement, and its lack of flexibility, meant that CHSRA would not have the ability to weigh the benefits of different alignment choices that might, as an example, add two minutes of travel time (if the travel time allowance was already exhausted) but save $1 billion. Undoubtedly, and whether this was fully intended by the drafters or not, this requirement has had significant impacts on the system's design and contributed to higher costs for the project.

The other main lesson from Proposition 1A is that when drafting ballot measures, it's important to understand and consider the balance of near-term project pressures (i.e., needing to draft something that can gain support and voter approval) and the long-term project interests that will be impacted by the language in the measure. While it's easy to point to Proposition 1A's travel time or other requirements as being burdensome and costly, the reality is that the ballot measure only passed with 53% of the vote. If one or more of those requirements were not included, then the measure may have failed to gain a majority and there would likely be no California HSR project to draw lessons from.

Conclusion

The California HSR project has had thousands of pages written about it and has generated strong views among both its supporters and detractors. In this paper I have tried to pull out the nuggets of wisdom from both successes and challenges that have had the biggest effect on the HSR project during my time working at CHSRA and that are most applicable and universal for other megaprojects. While much work remains on the HSR project, I firmly believe that the project is now past the point of no return and California will have a high-speed rail system. The main questions that remain will be how much of a high-speed rail system how soon and what future lessons that will offer.

About the Author

Boris Lipkin is Vice President of Program Development at STV. In this role Boris advises clients on strategies to advance large transportation programs through all stages of development. Prior to joining STV, Boris was appointed by Governor Edmund Brown and reappointed by Governor Gavin Newsom as the Northern California Regional Director at the California High-Speed Rail Authority (Authority) where he oversaw 160 miles of the statewide high-speed rail system. This work built on his previous appointment as the Deputy Director for Strategic Planning at the Authority where he led the development of the agency's business plans, funding strategies, and implementation plans. Boris has served on multiple boards and committees related to major transportation initiatives and has received multiple "Top 40 Under 40" awards. Boris holds a Master of City Planning degree from the University of Pennsylvania and Bachelor degrees in Business Economics and Geography from UCLA.