STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION

TECHNICAL REPORT DOCUMENTATION PAGE

DRISI-2011 (REV 10/1998)

Lock Data on Form

1. REPORT NUMBER CA20-3623	2. GOVERNMENT ASSOCIATION NUMBER	3. RECIPIENT'S CATALOG NUMBER
4. TITLE AND SUBTITLE Industry Capacity and Cost Escalation Study		5. REPORT DATE 2/17/20
		6. PERFORMING ORGANIZATION CODE HDR Inc.
7. AUTHOR Project Manager (DRISI): Akber Ali Transportation Engineer, Civil California Department of Transportation		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS HDR Inc. 201 California Street, Suite 1500 San Francisco, CA 94111		10. WORK UNIT NUMBER
		11. CONTRACT OR GRANT NUMBER 74A0936
12. SPONSORING AGENCY AND ADDRESS California Department of Transportation Division of Engineering Services 1801 30th St., MS-9-2/5i Sacramento, California 95816		13. TYPE OF REPORT AND PERIOD COVERED Final Report 09/10/2018 – 02/28/2020
		14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

In 2017, the California Legislature passed Senate Bill 1 (SB 1), which raises additional transportation funding through increases in the state gas excise tax, diesel excise tax, and license and registration fees. With the passage of SB 1, the California Department of Transportation (the Department) expects its program to grow significantly with similar expansions in the programs of local agencies. The infusion of additional spending has the potential to upend the transportation construction market (specifically highways and bridges) and lead to shortages of materials, fewer bids, and ultimately higher bid prices.

While this outcome is not a certainty, the Department needs a better understanding of the potential effects that additional work can have on future construction costs. The Department asked HDR to investigate four primary questions to help it understand the market dynamics from SB 1 funding and implications for construction cost escalation:

1. What is the effect of SB 1 funding on contractor competition and the capacity of the contracting industry to bid the work anticipated over the next 10 years?

2. What is the effect of SB 1 funding on availability and pricing of materials, such as aggregates for asphalt concrete, port land cement concrete, aggregate base, aggregate subbase, and steel?

3. What is the effect of SB 1 funding on the construction labor workforce, including skilled labor and trucking services, in California?

4. If SB 1 funding impacts contractor competition and materials availability, how would this influence the escalation of construction costs on the Department's projects?

Please see attached report for more details.

17. KEYWORDS Material, Cost escalation, Labor, equipment	18. DISTRIBUTION STATEMENT No restrictions.	
19. SECURITY CLASSIFICATION (*of this report*) Unclassified	20. NUMBER OF PAGES 253	21. COST OF REPORT CHARGED

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Impact of SB 1 on Construction Cost Escalation

Final Report

Sacramento, California

February 17, 2020

Executive Summary

In 2017, the California Legislature passed Senate Bill 1 (SB 1), which raises additional transportation funding through increases in the state gas excise tax, diesel excise tax, and license and registration fees. With the passage of SB 1, the California Department of Transportation (the Department) expects its program to grow significantly with similar expansions in the programs of local agencies. The infusion of additional spending has the potential to upend the transportation construction market (specifically highways and bridges) and lead to shortages of materials, fewer bids, and ultimately higher bid prices.

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2. What is the effect of SB 1 funding on availability and pricing of materials, such as aggregates for asphalt concrete, portland cement concrete, aggregate base, aggregate subbase, and steel?
3. What is the effect of SB 1 funding on the construction labor workforce, including skilled labor and trucking services, in California?
4. If SB 1 funding impacts contractor competition and materials availability, how would this influence the escalation of construction costs on the Department's projects?

HDR designed a study based on multiple sources of evidence to address each of these questions with the intent to produce actionable and transparent results. The study design incorporates five components:

1. *Financial and Business Analysis of SB 1 Fund Allocations and Awards.* HDR reviewed documents provided by Department staff or published online to understand how SB 1 funds are allocated and how they impact the overall construction industry.
2. *Stakeholder Input from Surveys and Focus Groups.* HDR designed four separate surveys to explore the key research areas. The table on the next page summarizes the types of questions posed by each survey and across the stakeholder groups. HDR also conducted a focus group session with a pool of survey respondents to explore answers further.
3. *Analysis of Wage and Employment Trends in the Heavy and Civil Construction Industry in California.* HDR used occupation data from the US Bureau of Labor Statistics (BLS) and the California Department of Industrial Relations (DIR) to understand whether trends in wages and employment in heavy civil construction occupations in California could be affected by SB 1.

4. *Literature Review.* HDR collected relevant research and investigations from publicly available sources to support our review of the highway and bridge construction industry in California.
5. *Modifying Construction Cost Escalation.* Prior to the current study, HDR had developed a methodology to forecast the California Highway Construction Cost Index (CHCCI). HDR updated these forecasts using more recent economic data and input provided by the surveys and the focus group. HDR also identified escalation associated with SB 1.

Questions Presented per Survey

Survey Questions	Construction Contractors	Materials Suppliers and Producers	Trade and Industry Associations	Government Staff
Respondent characteristics	✓	✓	✓	✓
Change in projects pursued or conducted	✓	✓		
Planned projects in next five years				✓
Workforce dynamics	✓	✓	✓	✓
Trucking availability	✓	✓	✓	
Change in materials availability and prices, and delivery schedules	✓	✓	✓	
Construction outlook	✓	✓	✓	✓

Study Findings

HDR found that as of November 2019, the impact of SB 1 funding has been modest. This is partially due to the rollout of SB 1 funding being in a transitional phase with additional funding and construction still ramping up.

SB 1's contribution to overall construction market: As of Fiscal Year 2018-19, SB 1 represents an increase of about 15% over the transportation funding available without the passage of SB 1. This is expected to grow as additional SB 1 funding sources become available until the SB 1 funding represents an increase of under 18%. When compared against the aggregate California construction market (which including non-transportation construction), SB 1 revenues are equivalent to only about 4% of total expenditures. While the appropriate comparison (transportation market or entire construction market) depends on the type of occupation and material, SB 1 represents an increase of 4% to 18% in construction spending. Although making up a smaller share of the Gross Regional Product (GRP) post-recession, California's construction market has grown faster than the rest of GRP and faster than US construction as a whole.

SB 1 Impact on Contractor Capacity: The survey results suggest that contractors who services to the Department have capacity as of 2019. While contractors indicated that they have worked on few SB 1 projects to date (typically 5 out of 79 projects). The majority of contractors (95%) said that they would consider bidding on future projects with SB 1 funding. There is a high level of optimism with 85% of construction contractors planning to expand their workforce at an average rate of 11% to 15%.

Feedback from industry and trade associations and focus group participants also show that the industry is growing capacity and looking for work. Focus group participants were

certain that if the industry could fulfill peak demand during 2004 to 2007, then they could meet the additional demand from SB 1. Focus group participants suggested that SB 1 funding would need to double or triple the current incremental increase before capacity problems would occur.

SB 1 Impact on Demand and Supply for Materials and Products: Construction contractors have experienced material delays, shortages, and increases in prices. They do not see this as a direct result of SB 1, but more as a result of growing number of infrastructure projects, economic growth, and tariffs coupled with difficulties finding trucking services. Some of the contractors who participated in the study recognized that materials could be available as required with better planning and organization within their own firms. The Department can help contractors with better planning by promoting use of 12-month and 24-month look ahead project reports.

Materials suppliers and producers have observed modest impacts as of 2019. Forty-six percent (46%) of suppliers experienced no real increase in the number of projects and almost 32% noticed a decrease in the number of projects compared to the previous fiscal year. Most firms (90%) have been able to provide customers with the materials or products in the quantity requested. Still, demand for materials has led to price increases with 71% of suppliers reporting average price increases of about 5% since 2018.

Suppliers and producers have a positive outlook on product availability given that the majority (74%) have a growth perspective towards the next five years, yet 21% felt shortages are looming. Focus group participants had a similar optimistic view of materials demand and supply, but they noted a few material shortages, such as fly-ash due to shrinking reserves and asphalt due to new regulations. Trucking shortages could be a risk for materials availability and higher costs.

SB 1 Impact on Availability of Construction Labor Skills and Wages**:** SB 1 could compound existing shortages of skilled labor. Contractors see shortages of skilled labor, particularly in the construction and extraction occupations. However, they feel the shortages are due primarily to changing demographics and career preferences rather than to SB 1. About a quarter of construction contractors attributed only some impact from SB 1 on labor shortages (21%) and some impact on wage increases (26%). Still, a large majority of contractors (85%) plan to expand their workforce in the next five years.

A trend analysis of BLS and DIR data did not show significant wage rate increases within the heavy and civil occupation categories since SB 1's implementation. The California construction industry is currently paying high wages, even higher than scale at times, due to labor and skills shortages. Construction contractors (36%), material suppliers and producers (43%), focus group participants and to some industry and trade associations flagged truck driver shortages as effecting materials availability or prices. Depending on whether it continues to apply to truck drivers, Assembly Bill 5 may have the unintended effect of exacerbating this shortage.

The Department's Capacity to Plan, Manage and Attract Bidders for Projects: At a minimum, the Department will need to maintain staffing levels, but optimally increased them. According to the survey of Department and local agencies employees, staff expect 16% to 20% of current engineers to retire over the next 5 years. Respondents were confident that they could handle the wave of retirements as the Department has a robust succession plan that includes good documentation, job rotation, and job shadowing.

Survey participants offered a number of suggestions on how the Department can improve its capacity to plan, manage, and attract bidders for projects as SB 1 funding results in additional projects. The focus group suggested that the Department improve the attractiveness of projects by revisiting complicated specifications, regulations, and other bureaucratic impediments. With the increase in industry mergers and acquisitions and changing business operations in construction firms, the Department should monitor the number of bidders on smaller projects (valued $10 million or less) and larger projects (valued greater than $10 million) to see whether the average number of bidders per project is decreasing over time, especially for the smaller projects. While industry consolidation reduces the number of firms overall, it may lead to larger firms with higher levels of capacity and flexibility. These firms are more likely to be attracted to bidding on larger projects.

Industry would like to have open communication with the Department about plans for letting SB 1 projects. Knowledge ahead of time about the number and types of projects would help construction contractors, materials suppliers and producers, and trade and industry associations plan for capacity and deliver services.

Update to the California Highway Construction Cost Index: More recent economic data show that economic growth will last longer than previously expected. Escalating labor and materials costs in the construction industry are expected to add 2.1% in construction cost escalation as a result of SB 1. The survey and focus group results suggest that industry will be able to increase capacity as the letting of construction accelerates with SB 1. Under this scenario, SB 1 will have no further effects on the construction cost index. If industry is unable to increase capacity commensurate with the increase in funding, then the average number of bidders per project will drop. In either case, the construction cost index is expected to grow through 2020 or 2021. After that, overall market forces due to a likely economic slowdown will cause construction costs to decline as they did in 2007 after the slump in the housing market and ensuing economic recession.

Suggestions for Implementation

Based on these findings, HDR suggests the following to help implementation of SB 1:

1. **Deliver projects slowly to let the market adjust.** The delays in SB 1 project delivery have been beneficial to the industry and given it time to adjust and prepare for increasing demand.
2. **Be realistic on what the Department communicates to better manage expectations.** The industry has complained about ramping up capacity to meet expected demand and being disappointed when extra construction spending did not materialize.
3. **Review bidding and construction regulations to make it easier for firms to submit bids and complete work for Caltrans**. Study participants suggested simple first steps: a) be flexible on start and end dates for projects, b) provide less rigid specifications regarding types of construction materials, tools or methods, and c) pay invoices on a timely basis.
4. **Improve cost estimation to optimize the use of available funds, remain competitive, and attract multiple bidders.** The Department should use the

updated CHCCI to forecasts costs and factor in trucking costs for sites that are far from aggregates or plants and incorporate expected increases in wages, materials, and transportation costs.

Prospective Next Steps

The Department needs to continue leveraging existing partnerships and fostering opportunities to collaborate and streamline working relationships, while still respecting labor and environmental regulations. With the Department committed to rolling out projects in a timely and cost effective manner, HDR has the following suggestions as prospective next steps:

1. Keep up internal hiring goals and training to have adequate and trained staff who can meet SB 1 demand
2. Partner with industry to keep pace with construction best practices such as materials composition, equipment improvements, paving processes, environmental impacts, sustainability, and staff recruiting and training
3. Use the updated CHCCI to forecast highway construction costs up to the fourth quarter of 2028
4. Refresh the CHCCI forecast on an annual basis to incorporate the latest trends in materials, wages and transportation costs. Consider creating a separate construction cost index by major item classification.
5. Monitor changes in industry consolidation and firm composition to anticipate contractor capacity to bid
6. Build and maintain a documented, accessible, electronic database of bid data to monitor the construction and materials market through changes in pricing and number of bidders per bid
7. Provide regular progress reports to industry on SB 1 roll out and completions to help contractors and material suppliers forecast their capacity needs.

HDR's study approach enabled it to gather information across a broad spectrum of construction industry stakeholders and researchers. The majority of construction contractors and material suppliers and producers were optimistic in their plans to grow and find more work. A message HDR repeatedly read and heard was that construction contractors and material suppliers and producers and their association representatives genuinely want to partner with the Department to keep California's transportation infrastructure working.

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Acronyms and Abbreviations

AB	Assembly Bill
AGC	Associated General Contractors of America
ATP	Active Transportation Program
BEA	US Bureau of Economic Analysis
BLS	US Bureau of Labor Statistics
BOE	California Board of Equalization
CHCCI	California Highway Construction Cost Index
CMGC	construction manager/general contractor
COS	Capital Outlay Support
CPI	consumer price index
CTC	California Transportation Commission
DBB	design bid build
DIR	California Department of Industrial Relations
DOT	department of transportation
FY	fiscal year
GDP	gross domestic product
GRP	gross regional product
ITB	invitation to bid
LAO	California Legislative Analyst's Office
LPP-C	Local Partnership Program – Competitive
M&A	mergers and acquisitions
MOU	memorandum of understanding
RFP	request for proposal
SB	Senate Bill
SCCP	Solutions for Congested Corridors Program
SHOPP	State Highway Operation and Protection Program
STIP	State Transportation Improvement Program
TCEP	Trade Corridor Enhancement Program
TRB	Transportation Research Board
TxDOT	Texas Department of Transportation

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Chapter 1. Study Design

1.1 Study Objective

The California Department of Transportation (Caltrans or the Department) delivers a large construction program on an annual basis. In 2017, the California Legislature passed Senate Bill 1 (SB 1), which raises additional transportation funding through increases in the state gas excise tax, diesel excise tax, and license and registration fees. With the passage of SB 1, the Department expects its program to grow significantly with similar expansions in the programs of local agencies. The infusion of additional spending has the potential to upend the transportation construction market and lead to shortages of materials, higher bid prices, and fewer bids.

While this outcome is not a certainty, the Department needs a better understanding of the potential effects that additional work can have on future construction costs. This will allow the Department to provide better cost estimates on projects. If costs increase faster than current California Highway Construction Cost Index (CHCCI) forecasts, engineering estimates could be significantly lower than what bidders submit, resulting in delays to awarding the programmed projects and erosion in the purchasing power of SB 1 funding. With augmented funding comes the need for greater oversight and accountability, so the Department can deliver on the promise of SB 1.

Caltrans asked HDR to investigate four primary questions to help the Department understand the market dynamics from SB 1 funding and the implications for construction cost escalation:

Key Outcome from Study

Caltrans has the ability to adjust the CHCCI in anticipation of escalating construction cost estimates.

1. What is the effect of SB 1 funding on contractor competition? Specifically, does the contracting industry have the capacity to bid the volume of work anticipated over the next 10 years? Other areas of exploration include how Caltrans can package projects to maximize the use of contractors of all sizes.
2. What is the effect of SB 1 funding on materials availability and pricing, such as aggregates for asphalt concrete, portland cement concrete, aggregate base and aggregate subbase, and steel? Will asphalt plants in California have the capacity to meet demand, and do geographic differences factor into materials availability?
3. What is the effect of SB 1 funding on the construction labor workforce in California? Are there shortages of skilled labor and trucking services? If so, how will those shortages affect the Department's projects? How will staff turnover and hiring rates affect the Department's ability to plan and manage the incremental increase in the number or size of highway and bridge construction projects due to additional funding?
4. If SB 1 funding has an effect on contractor competition and materials availability, how would this effect influence construction cost escalation on Caltrans projects? If so, can the CHCCI (which uses historical bid data) be forecasted to account for these effects on future construction costs?

This report is organized around these four primary questions. In the report, HDR provides evidence from several lines of investigation to respond to the questions. The report also provides recommendations for further analysis and research, including recommendations for an updated methodology to capture the potential escalation on the Department's construction projects. HDR used public data sources, the Department data sources, and industry input to conduct the research described in this report.

1.2 Design and Methodology

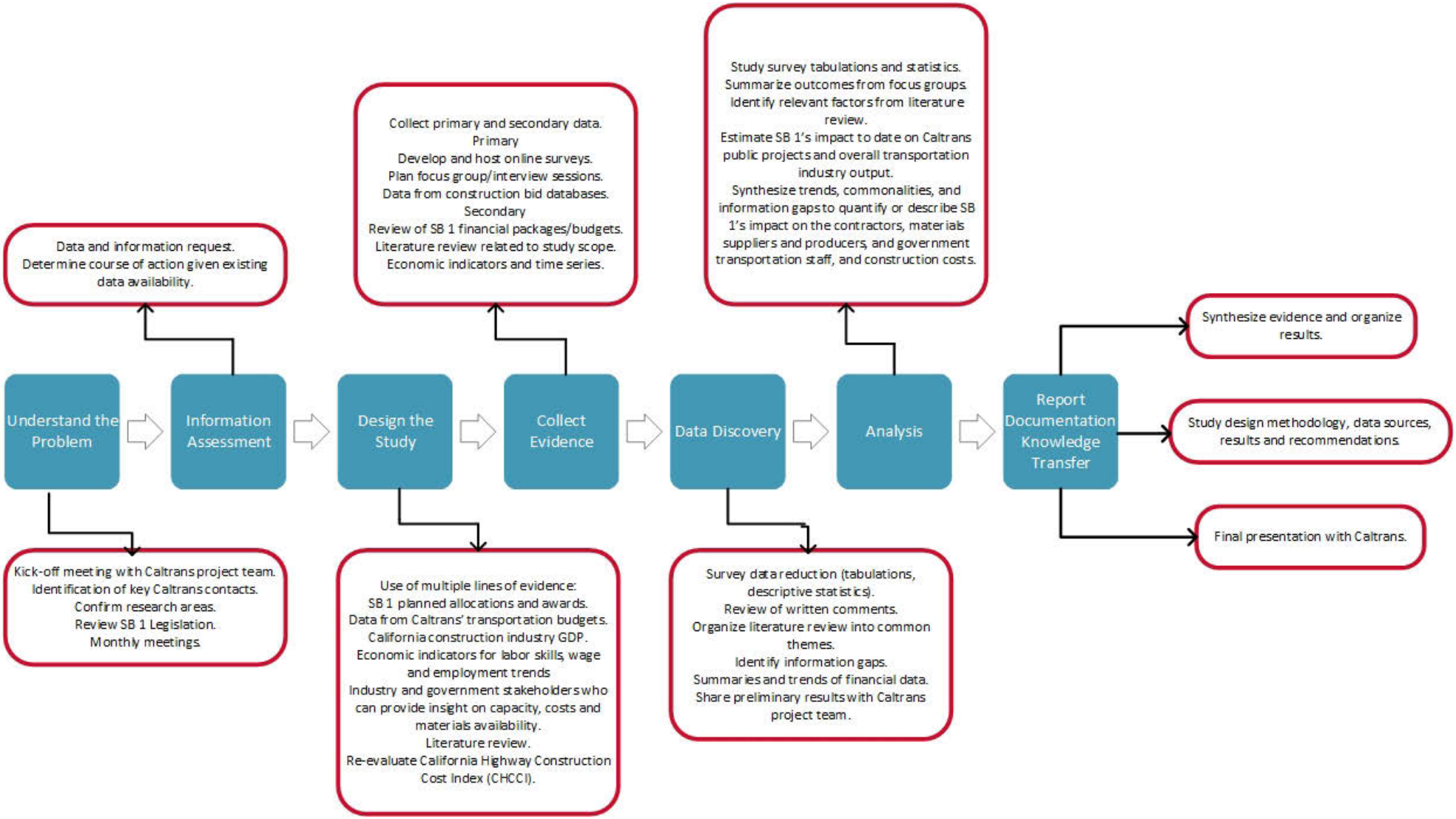
HDR implemented a study design based on multiple sources of evidence to address each of the four research investigations. We followed a structured framework that allows for actionable and transparent results (see Figure 1-1).

HDR began the study by presenting an overview of our project understanding to the Caltrans study team during a kickoff meeting held on May 30, 2019. We worked with the Department's representatives to refine the questions to be addressed. Collectively, the group decided to focus on questions likely to be answered by the study.

Once the objectives for the research investigations were finalized, HDR submitted detailed data requests to Caltrans to access in-house data or reports that could be used to support the research investigations. Based on what the Department was able to provide in a timely manner, HDR reassessed data needs and refined the study design.

For example, based on our assessment of available data, HDR incorporated a data-driven financial analysis of SB 1's effects using the Department's system of transportation accounts, the rules and regulations governing the distribution of collected excise taxes, and SB 1's relative contribution to the overall valuation of the construction industry in California. Because detailed bid data were not available in a format suitable for analysis and the SB 1 project roll-out was still in a transitional phase as of the second and third quarters of 2019, HDR recommended a review of programmed and awarded projects in financial packages and budget reports as an alternative way to assess the effect that SB 1 has had on the construction market to date.

Figure 1-1. Study Design Framework



1.2.1 Study Design

Study Design

The study included an analysis of funding and construction trends, surveys, focus groups, and literature reviews.

HDR used a descriptive study design to satisfy the requirements of the study and answer the primary questions described in Section 1.1. We incorporated five components into the study design. These involved tracking SB 1 fund allocations and awards, conducting surveys and focus groups, analyzing wage and employment trends in the California construction industry, compiling publicly available literature related to the four primary questions, and assessing how the CHCCI can be revised to predict cost escalation rates. Details about each of these design components are provided in the sections that follow.

Financial and Business Analysis of SB 1 Fund Allocations and Awards

HDR conducted a financial and business analysis of SB 1 funds. We looked at several documents obtained from Department staff or published online in order to understand how SB 1 funds are allocated and awarded and how they impact the overall construction industry.

HDR conducted a literature review of SB 1. We found detailed information on SB 1's goals and objectives with regards to rebuilding California. We also looked at data obtained from the Caltrans Division of Budgets to understand the magnitude of revenues that SB 1 will generate over the next decade and where these revenues will be invested. We also looked at the California Transportation Funding Package to understand the impacts of SB 1 funds on transportation funds statewide. The findings of the financial and business analysis are summarized in Chapter 2.

Stakeholder Input from Surveys and Focus Groups

The contractors and suppliers working on Caltrans projects are on the frontline in project delivery and feel the direct effects of increased construction funding relative to recent years. Their experiences, opinions, and input at the time of the surveys provided a candid view of how SB 1 has affected the construction industry to date. This perspective is limited by the fact that SB 1 funding is still being allocated and programmed, so the market had not seen the full impact of the new funding. Although the associations and agencies that provide construction services and products are one step removed from the physical labor of highway and bridge construction, they have a "big-picture" understanding of how SB 1 has and could affect the construction industry in California.

The Department and its regional and local partners provide the demand for construction services. By surveying government staff who plan, manage, and deliver construction projects, the Department can gauge staff readiness to support an increase in the number of projects or the size of awards.

HDR designed four separate surveys to explore the key research areas of contractor capacity, materials availability and prices, skilled workforce availability and wages, and government agency capacity to deliver projects in light of SB 1 funding. Each of the four

stakeholder groups had its own survey questionnaire. HDR developed draft versions of each questionnaire, which were circulated to the Caltrans study team. All comments and edits from the Department were addressed and incorporated into the final versions of the questionnaires.

After the questionnaires were finalized, HDR coded them into SurveyMonkey (a web-based survey tool).[1] Appendices A through D of this report provide copies of the final surveys. Table 1-1 summarizes the types of questions posed by each survey and shows the commonalities of issues across the stakeholder groups.

Table 1-1. Questions Presented per Survey

Respondent characteristics	✓	✓	✓	✓
Planned projects in next five years				✓
Workforce dynamics	✓	✓	✓	✓
Trucking availability	✓	✓	✓	
Change in materials availability and prices, and delivery schedules	✓	✓	✓	
Construction outlook	✓	✓	✓	✓

Survey invitations were emailed to potential respondents in each stakeholder group over July, August, and September 2019. Table 1-2 summarizes the number of invitees, survey responses, and response rates. To encourage a response rate as high as possible, HDR sent out email reminders and made phone calls over the same period. After each survey was completed, HDR tracked which respondents completed all or only some of the questions. Appendices A through D provide the detailed methodological approaches and analyses conducted for each survey.

Enough surveys were completed for the construction contractors, materials suppliers and producers, and government staff stakeholder groups to provide good insight into their opinions and experiences. Since only a small number of members of the targeted associations attempted the survey, these results are qualitative. Nonetheless, the findings from the associations' survey were in agreement with the findings from the other stakeholders.

Table 1-2. Numbers of Survey Invitations and Responses

Survey	Invitations	Valid Emails	Fully Completed	Partially Completed	Survey Response Rate
Construction Contractors	1,314	1,110	40	44	7.6%
Materials Suppliers and Producers	529	409	21	12	8.1%
Trade and Industry Associations	246	195	7	2	4.1%
Government Staff	131	131	17	19	≤ 27.5%

[1] SurveyMonkey Inc., San Mateo, California, USA, Main Website: www.surveymonkey.com

Common Theme

Contractors, material suppliers and producers, and trade associations are not seeing the influx of projects they anticipated under SB 1.

A common theme shared by construction contractors, materials suppliers and producers, and trade associations across the surveys was that they have not seen the influx of projects that they anticipated under SB 1. Hence, the surveys responses did not identify major issues related to bidders being able to meet the capacity demanded from new projects. The study team realized that we should follow up with survey respondents to explore at what point the industry would start having capacity issues. A focus group was conducted on November 11, 2019, via webinar. HDR invited survey respondents to participate in the focus group. Five respondents participated in the focus group. Details regarding the focus group methodology and results are provided in Appendix E.

Analysis of Wage and Employment Trends in the Heavy and Civil Construction Industry in California

Government agencies such as the US Bureau of Labor Statistics (BLS) and the California Department of Industrial Relations (DIR) generate and maintain detailed economic data on wage or employment trends for occupation categories. HDR referenced these sources to better understand whether trends in wages and employment in heavy civil construction occupations in California could be affected by SB 1. With respect to the BLS data, HDR conducted a statistical analysis of employment and wage trends from 2012 to 2018 and compared them with trends at the national level using linear regression methods.

DIR data was not available in a convenient database format. To conduct an analysis on this data, HDR identified trades that are markers for wage trends in the California highway and bridge construction industry. Once these were identified and confirmed by the Department, HDR manually parsed key wage data from each selected trade and jurisdiction-specific PDF (portable document format) file and converted the information into a Microsoft Excel spreadsheet format. The wage data from 2012 to June 2019 could then be used to model whether trends over the study period were changing. HDR hypothesized that if SB 1 has had an effect, then either the rate of change in wages since 2017 would be higher compared to trades outside the heavy civil construction industry (e.g., telecommunication technicians), or the rate of change would be higher than the observed rate changes prior to SB 1's implementation.

The results from these two separate analyses are provided in Sections 5.3 (BLS data) and 5.4 (DIR data) of this report.

Literature Review

HDR collected relevant research and investigations from publicly available sources to support our review of the highway and bridge construction industry in California. This review found that the construction industry in the US contributed 4.1% towards the total US gross domestic product (GDP) in 2018 (Ken Simonson, Associated General Contractors, September 17, 2019). The California construction industry is not far behind national levels with construction comprising 3.8% of California's gross regional product (GRP). Given the importance of construction to California's economy, an abundance of

market, business, and economic analyses in the heavy civil construction industry (and specifically in the highway and bridge construction industry) are available in the public domain.

HDR found a number of articles and documents related to the capacity of contractors to bid on highway construction projects, shortages of skilled construction labor, shortages of trucking and freight services, and effects from materials availability. HDR used this information to better inform and add context to the findings from the online surveys and focus group. The set of documents that HDR reviewed is listed in Appendix F of this report.

Modifying Construction Cost Escalation

Prior to the current study, HDR had developed a methodology to forecast the California Highway Construction Cost Index (CHCCI). The methodology uses econometric (statistical) analysis to account for seasonality and market factors that affect construction prices. The methodology addresses a number factors, such as diesel fuel prices, mortgage rates, and the average number of bidders. However, it does not consider the potential market shock that SB 1 could have on construction costs.

Using input provided by the surveys and the focus group described earlier, HDR updated the prior CHCCI forecasts. The updates take into account more recent economic data that show economic growth has continued longer than anticipated in the prior forecasts. This means that CHCCI growth will last longer than previously expected. The updates also consider the effect of SB 1 on labor costs and industry capacity. To account for the escalation in labor costs, wage rate growth of 2.1% (based on the survey and focus group data) was incorporated into to all forecasts. To account for changes in industry capacity, HDR tested scenarios with different average numbers of bidders.

The forecasts show that SB 1 affects construction costs in the near term, but overall market forces still drive the forecast. Costs are expected to increase through 2020 or 2021, but then decline due to a contracting economy.

Construction Costs

SB 1 affects costs in the near term, but other market forces are likely to lead to declining costs in 2020 or 2021.

1.2.2 Data Collection

This section summarizes the sources and means HDR used to collect data and inform the study. Over the course of the study, the Department provided and shared several items:

- Financial and budget reports tracking the awarded and allocated SB 1 funds
- Dataset of State Highway Operation and Protection Program (SHOPP) and State Transportation Improvement Program (STIP) awarded projects and costs from July 2010 to August 2019
- Labor surcharge calculations using DIR’s general prevailing wage rates
- Lists of construction contractors (with names and emails) who bid on Caltrans projects between January 2010 and August 2019

- Names and emails of Department staff (headquarters and district) involved in cost estimation, project management, construction, design, and planning of construction projects.

In addition to the data provided by Caltrans, HDR collected other information and data from a number of primary and secondary sources. These sources are described below.

Primary Sources

HDR collected information and data from the following primary sources:

- Surveys of construction contractors, materials suppliers and producers, industry and trade associations, and California government staff from the Department and local agencies involved in highway and bridge construction projects
- Discussions with focus group industry participants.

HDR was unable to conduct trend analyses on historical bids because the Department's detailed data on winning bids at the item level were not available in a database format.

Secondary Sources

HDR collected information and data from the following secondary sources:

- List of contact names and emails from ReferenceUSA[2] targeting materials suppliers and producers and industry and trade associations in California
- Occupation employment statistics for total annual employment and wages by major occupation type in the heavy and civil engineering industry in California and the United States for 2012 to 2018, from BLS
- Director's General Prevailing Wage Determinations, 2012 to 2019, from DIR.

HDR also collected publicly available research and analyses from various sources such as:

- Government or nonprofit sources such as Caltrans, the California Geological Society (GGS), the Public Policy Institute of California, the Transportation Research Board (TRB), and universities
- Academic journals (e.g., *Journal of Management in Engineering* and *Equipment World*)
- Trade or news associations, (e.g., *Engineering News-Record*).

1.2.3 Data Discovery

The data discovery phase was an ongoing process as HDR collected and reviewed the data. The survey results were stored in the statistical software package SPSS.[3] Using this software, HDR quickly able to quickly assess the quality of the data and monitor response rates over time. At this point, information gaps were assessed. Data from BLS

[2] http://resource.referenceusa.com/

[3] IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

and DIR were downloaded, documented, and transformed where necessary to conduct statistical analyses of wage and employment trends over time, jurisdiction, and occupation group.

HDR shared our initial data discoveries with the Caltrans study team during monthly meetings to obtain their feedback and insight. HDR collected and organized California's transportation financial packages and transportation budgets that referenced SB 1 funds and allocation schemes since fiscal year (FY) 2017-18. We tracked Gross Regional Product (GRP) from the US Bureau of Economic Analysis (BEA) and construction spending data from the US Census Bureau for the California construction industry over the same period. HDR transcribed the numbers into Microsoft Excel format and applied our best economic and business judgment to explain SB 1's standing in relation to California's transportation repair and maintenance funding and its overall construction industry.

1.2.4 Analysis

The objective of the analysis phase was to synthesize trends, commonalities, and information gaps to support or refute SB 1's incremental effect on contractors, material suppliers and producers, and government transportation staff. The analysis portion of the study design assessed quantitative results (e.g., results reported as specific percentages or medians), qualitative observations (e.g., comments provided by the survey and focus group participants), and trends (e.g., changes in construction wages evaluated across multiple lines of evidence).

HDR sought to find commonalities across the different sources of evidence to substantiate our findings and recommendations. When there were incongruities, HDR hypothesized as to the reasons for the dissimilar findings and found references from the collected data to explain the differences.

The following is an example of the analysis process. HDR reviewed a memorandum from the Department titled "2018 Aggregate Resource Policy Statement and Tools" from March 1, 2018, and a 2018 report from the California Geological Survey titled *Aggregate Sustainability in California*. These sources mentioned possible shortages of aggregates over a 50-year horizon. One of the investigation areas the Department wants to better understand is materials availability. Some of the questions in the surveys asked respondents about materials availability. Depending on the respondent and the material in question, there was either ample supply or not. From HDR's review of the responses, some materials were available in some of the Department districts but not others, and HDR hypothesized that this might explain some of the differences in respondents' opinions or experiences.

One of the common themes across the surveys was that the majority of contractors or materials suppliers and producers did not think that SB 1 was affecting their capacity or leading to production issues or they could not comment on SB 1's effects. How would this lack of awareness regarding SB 1's effects help the Department better understand SB 1's effects?

During the focus group sessions, HDR asked at what hypothetical level would contractors and materials suppliers and producers start to be concerned about capacity. It was difficult for the participants to provide a uniform answer. When pressed, some

participants said that they have not yet seen the same peak levels of project awards that they observed during the 2004-2007 period. The message was that if they could deliver back then, they could deliver now even if the project numbers or awards were to rise to those peak levels. Others postulated that it would require about two to three times the recent incremental increases of project awards over the previous year before construction services would face supply shortages.

To further help the Department better understand the current situation of contractors' capacity and materials availability, HDR studied trends and projections available in the Department's financial packages and budgets specifically tracking SB 1 funds. Based on HDR's findings from this financial and budget review, the survey and focus group findings would be substantiated, refuted, or a mix of both conditional on certain topics.

Ability to Meet SB 1 Demand

Focus group participants have not yet seen the demand observed during the 2004-2007 peak period. Two to three times the recent incremental increase would be necessary before supply shortages may occur.

Overall, HDR strove during the analysis portion of the study to break down complex concepts into smaller pieces and then rebuild the story of SB 1's current and conjectured forecasted effects on the construction industry in California in a comprehensible and transparent manner.

1.2.5 Reporting, Documentation, and Knowledge Transfer

HDR reviewed and organized the results of the analysis to document our findings in a coherent manner. The outline and content needed to be organized so the Department could make informed business decisions. Before we began working on the report, HDR circulated a report outline for the Department to review and provide feedback. The final report outline then became the framework for this report.

The detailed methodological approaches used in the study are provided in Appendices A through D for reference. The discussions and findings that form the body of this report draw from the information in the appendices. HDR prepared a draft report for the Department to review. After the Caltrans study team submitted comments, HDR updated the report as a final version.

To close out the study, HDR presented key findings to senior Caltrans management. The presentation and documentation in Microsoft PowerPoint informed the Department and provided an opportunity for questions and answers regarding HDR's recommendations and actions for next steps.

Chapter 2. SB 1 Overview

The purpose of this analysis is to understand how SB 1 impacts the construction industry and ultimately construction cost escalation in California. This chapter provides a brief overview of SB 1, a financial analysis of the bill, a discussion of how revenues generated from this bill are distributed, and an evaluation of SB 1's contribution to the overall construction market.

2.1 SB 1 Description and History

SB 1, also known as the Road Repair and Accountability Act of 2017 or "Gas Tax," is a bill introduced on December 6, 2016. SB 1 is a landmark transportation investment and aims to rebuild California by repairing neighborhood streets, freeways and bridges, improving traffic safety, and expanding public transit systems across the state. This legislative bill passed 27-11 in the State Senate and 54-26 in the State Assembly on April 6, 2017. SB 1 was signed into law on April 28, 2017.

The bill introduces a 12-cent gas excise tax increase, a 20-cent diesel excise tax increase, new vehicle license and registration fees, and is projected to invest approximately $52.0 billion to $54.0 billion over the next decade (~$5.2 billion to $5.4 billion annually) to address a backlog of repairs and upgrades and ensure a cleaner and more sustainable travel network for the future.

SB 1 generated funds will be split equally between state and local investments. According to the State's SB 1 website,[4] California state-maintained transportation infrastructure will receive approximately $26 billion over the next ten years (or $2.6 billion annually). The other half will go to local roads, transit agencies, and pedestrian and cycle routes.

Table 2-1 summarizes where annual funds are expected to be invested once new and increased existing revenues are generated. These revenues are phased over different time periods. All funding categories will take effect by July 2020 at the latest.[5]

Table 2-1. SB 1 Annual Investment over the Next Decade

Category	Investment Amount (Millions of Dollars)
Maintenance and Rehabilitation of the State Highway System	$1,800
Maintaining and Repairing the State's Bridges and Culverts	$400
Repairs to Local Streets and Roads	$1,500
Matching Funds for Local Agencies	$200
Bike and pedestrian projects	$100

[4] http://rebuildingca.ca.gov/overview.html

[5] See Section 2.2 for more information on SB 1 revenues.

Table 2-1. SB 1 Annual Investment over the Next Decade

Category	Investment Amount (Millions of Dollars)
Freeway Service Patrol	$25
New Funding to Transit Agencies	> $750
Trade Corridor Enhancement Program	$300.0
Solutions for Congested Corridors Program	$250.0
Local Planning Grants	$25.0
Transportation-Related Research at state universities	$7.0
Workforce Training Programs	$5.0
Total	**$5,362.0**

Source: State of California website. Last accessed via the following link on December 9, 2019. http://rebuildingca.ca.gov/overview.html

HDR estimates that at least 81% of this funding is going to affect bids (i.e., allocated to capital and maintenance expenditures of the infrastructure). This includes maintaining and rehabilitating the state highway system, maintaining and repairing the state's bridges and culverts, repairing local streets and roads, bike and pedestrian projects, the Trade Corridor Enhancement Program, and the Solutions for Congested Corridors Program. Some items, such as freeway service patrol and workforce training programs, do not affect construction demand. Others, such as matching funds for local agencies and new funding for transit agencies, may affect construction bids depending on whether funds are used for capital, operating, or planning expenses.

SB 1 includes a number of reforms. Some of these are presented below:[6]

- Requires the California Transportation Commission (CTC) to allocate the Department's Capital Outlay Support (preconstruction) for SHOPP projects, consistent with the CTC's recommendation in the 2016 Annual Report.
- Requires the CTC to hold accountable both the Department and the cities/counties receiving road repair and maintenance funding through annual reporting.

Proposition 69 also known as the Transportation Taxes and Fees Lockbox and Appropriations Limit Exemption Amendment ensures that revenues from SB 1 can be used only for transportation purposes. This proposition amends the State Constitution to require that the Legislature spend revenues from the new diesel sales taxes and

[6] Accountability and Reform Measures can be accessed via the following link: https://catc.ca.gov/programs/sb1/accountability-and-reform-measures Last accessed on December 9, 2019.

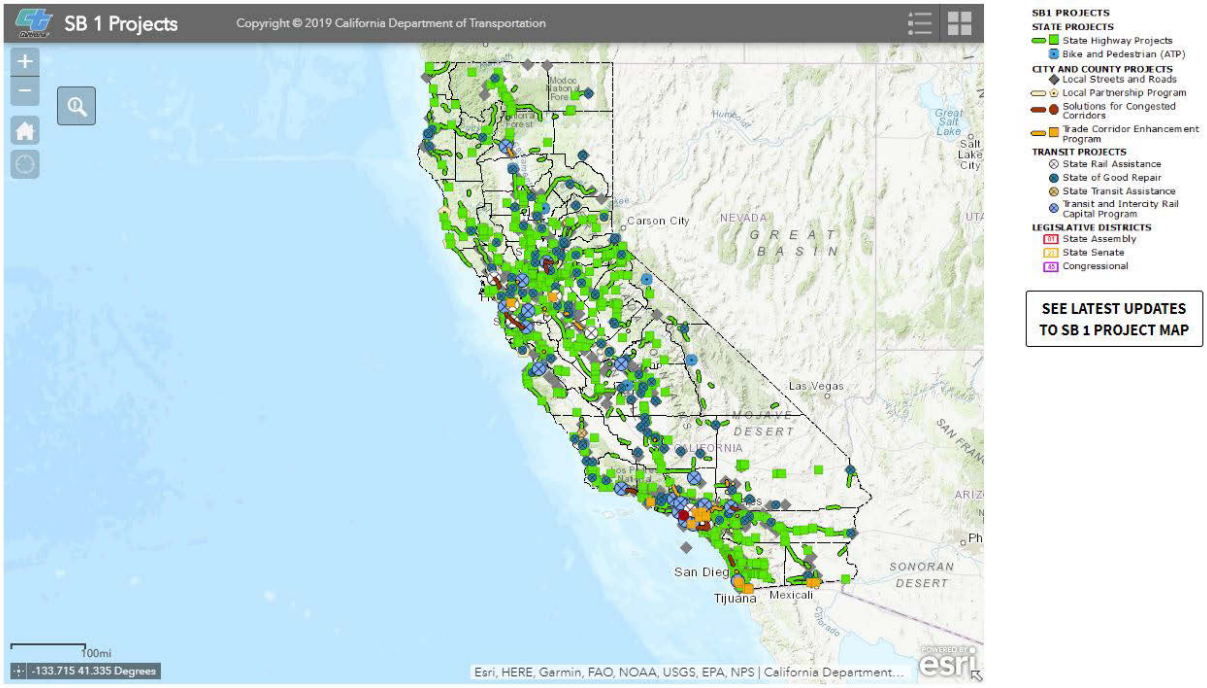
transportation improvement fees on transportation-related purposes.[7] Furthermore, Proposition 69 prohibits the state from:

- Loaning these revenues (except for cash flow purposes)
- Using transportation improvement fee revenues to repay state transportation bonds without voter approval.

Approximately 81% of voters supported this amendment on June 5, 2018. Proposition 69 exempts spending from all the revenues raised from SB 1 from counting toward state and local spending limits.[8]

SB 1 projects are expected to be spread out across the state. The map below shows the location and type of transportation projects (e.g., state highway projects, bike and pedestrian, local streets and roads, etc.) that the state and local communities are investing in with SB 1 revenue.[9] This map includes projects at all phase of project delivery. Some may be currently in the project study phase, while others are out for bid or in construction. The pace of project delivery has a big impact on what contractors and suppliers experience in the construction industry.

Figure 2-1. Map of SB 1 Projects



Source: State of California website. http://rebuildingca.ca.gov/map.html
Note: map as of December 9, 2019

[7] Note that this also applies to existing diesel sales tax revenues.

[8] More information on Proposition 69 can be accessed via the following link: https://lao.ca.gov/BallotAnalysis/Proposition?number=69&year=2018 Last accessed on December 9, 2019.

[9] SB 1 full projects' list can be accessed via the following link: http://rebuildingca.ca.gov/map.html Last accessed on December 9, 2019.

2.2 SB 1 Impact on California Transportation Funding

According to the Caltrans Division of Budgets, SB 1 will generate approximately $5.3 billion annually in increases from new revenues and existing revenues. These revenues phase in over different time periods.

New revenues will total approximately $4.6 billion and include:

- Diesel Excise Tax (20-cent increase) - $649.0 million, effective November 2017
- Gasoline Excise Tax (12-cent increase) - $1.9 billion, effective November 2017
- Zero-Emission Vehicles Road Improvement Fee ($100 per vehicle) - $87.0 million, effective July 2020
- Transportation Improvement Fee ($25 to $175 per vehicle) - $1.6 billion, effective January 2018
- Diesel Sales Tax (4% increase) - $364.0 million, effective November 2017.

Increases to existing revenues will total approximately $0.7 billion and include:

- Incremental Excise Tax (17.3-cent reset + inflation adjustment) - $319.0 million, effective July 2019
- Gasoline Base Excise Tax (inflation adjustment) - $285.0 million, effective July 2020
- Diesel Excise Tax (inflation adjustment) - $110.0 million, effective July 2020.

The infographic in Figure 2-2 shows a flow of SB 1 revenues and where these revenues will be invested. Note that changes in gas consumption over time is related to more efficient vehicles and other social trends such as electric cars, carsharing, and ridesharing that may impact the forecasted revenues from SB 1.

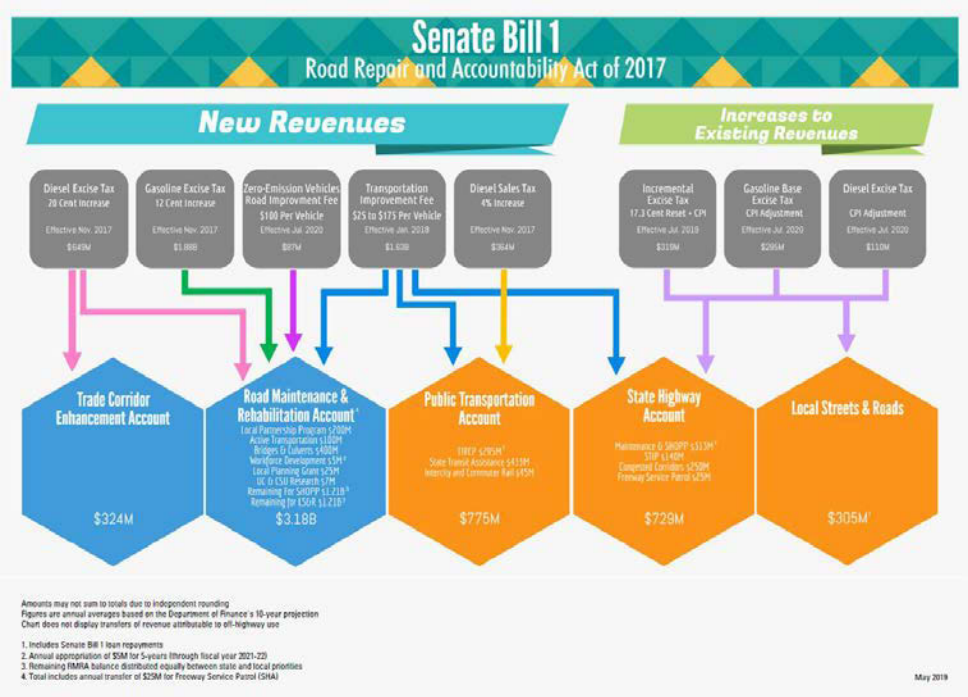
As part of its annual guide to transportation funding in California, the Caltrans Office of Economics and Data Management in the Division of Transportation Planning compiles information on highway and transit funding using data from the State Controller's office. The most recent analysis indicates that about $28.7 billion in transportation funding was available for FY2016-17. Since the first set of SB 1 funding revenues did not take effect until November 2017, these figures provide an estimate of the transportation funding available in California prior to SB 1.

Table 2-2 shows approximate transportation revenues by source. The largest category are the local transportation sales tax measures passed in self-help counties (i.e., counties where voters have chosen to tax themselves for transportation funding). Overall, local revenues dwarf state and federal revenues with a total of $16.6 billion in transportation funding. As shown in Figure 2-3, more than half of California transportation funding comes from local sources, while the remainder comes from state and federal sources.

The FY2016-17 figures do not include substantial revenue from Los Angeles County Measure M, which took effect July 1, 2017. The Office of Economics and Data Management estimates that Measure M will raise about $850 million in 2019. The FY2016-17 figures also exclude other self-help taxes passed after the fiscal year, such

as the San Mateo Measure W which will raise $90 million and the San Benito transportation sales tax which will raise $8 million in 2019

Figure 2-2. SB 1 Flowchart



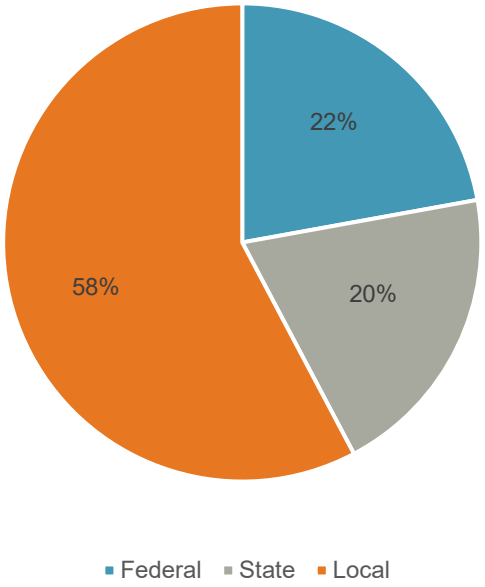
Source: Caltrans Division of Budgets

Table 2-2. Sources of California Transportation Revenue

Category	Amount (in millions)
Federal Revenues	**$6,355**
Federal Funds to State Highway	$4,855
Federal Funds to Transit Operators	$1,500
State Revenues	**$5,771**
Weight Fees	$1,053
Base Excise Tax	$2,890
Gasoline Sales Tax/Swap Excise	$1,326
Diesel Sales Tax	$502
Local Revenues	**$16,566**
Transportation Development Act (1/4% from BOE)	$1,626
Local Transportation Sales Tax Measures	$5,058
Regional Transportation Planning Agency Revenues	$2,241
Transit Revenues	$3,142
Street and Road Revenues	$4,500
Grand Total	**$28,730 ***

* Includes $38 million in federal high-speed rail funding.
Source: Caltrans analysis of financial data from California State Controller's Office.

Figure 2-3. California Transportation Funds by Source



Source: Caltrans analysis of financial data from California State Controller's Office.

SB 1 as a Share of Transportation Funding

As of the 2018-19 fiscal year, SB 1 represents a 15% increase in available funding. This will grow as additional SB 1 funding sources become available.

SB 1 revenues (effective November 2017 and January 2018) represent an increase of approximately 15.7% over the $28.7 billion in California transportation revenues available in FY2016-17 when other transportation sources are held constant. This percentage would be slightly lower if revenue increases (e.g., due to higher retail sales) were taken into account. If the additional sales tax measures passed since FY2016-17 (such as Measure M) are included (but other sources are held constant), this increment drops to about 15%.[10] SB 1's share of funding is expected to grow as additional revenues become available in July 2019 and July 2020. If other revenue sources are held constant, the additional revenues mean that SB 1 funding will provide an increase of less than 18% over the funding available without SB 1.

The marketplace has likely not yet experienced the full impact of the additional 15% funding available today (let alone the 18% increase available in future years) due to lags in the timing of generating, programming, and allocating revenues. In addition, even when revenues are allocated to projects, the impact on the construction industry will not be immediate as projects are in various phases of design and construction. The result is slower growth in construction spending than the 15% increase might suggest. HDR was unable to determine the share of SB 1 revenues currently invested in construction.

[10] This analysis excludes the $38 million in federal high-speed rail funding available in FY2016-17.

In 2018, SB 1 funding provided the following allocations:[11]

- **State Highway Operation and Protection Program (SHOPP)**
  4-Year Period (FY 2018-19 through FY 2021-22)
  - Programmed SB 1 funds: $6.8 billion
  - SB 1 dollars allocated: $920.0 million
  - Number of allocated projects: 381
  - Number of awarded projects: 21
  - Total dollars for awarded projects: $251.0 million
- **Trade Corridor Enhancement Program (TCEP)**
  3-Year Period (FY 2017-18 through FY 2019-20)
  - Programmed SB 1 funds: $794.0 million
  - SB 1 dollars allocated: $79.9 million
  - Number of allocated projects: 14
  - Number of awarded projects: 0
  - Total dollars for awarded projects: $0
- **Solutions for Congested Corridors Program (SCCP)**
  4-Year Period (FY 2017-18 through 2020-21)
  - Programmed SB 1 funds: $1.0 billion
  - SB 1 dollars allocated: $243.0 million
  - Number of allocated projects: 3
  - Number of awarded projects: 0
  - Total dollars for awarded projects: $0
- **Local Partnership Program – Competitive (LPP-C)**
  3-Year Period (FY 2017-18 through 2019-20)
  - Programmed SB 1 funds: $309.0 million
  - SB 1 dollars allocated: $59.6 million
  - Number of allocated projects: 4
  - Number of awarded projects: 0
  - Total dollars for awarded projects: $0

[11] Caltrans. Senate Bill 1 Program Progress Report to the California Transportation Commission for the Period: March 1, 2018 – August 31, 2018, accessed via the following link: https://dot.ca.gov/-/media/dot-media/programs/sb1/documents/sb1-progress-report-1018.pdf
Last accessed on December 11, 2019.

- **Active Transportation Program (ATP)**
  2-Year Period (FY 2017-18 and FY 2018-19)
    - Programmed SB 1 funds: $200.0 million
    - SB 1 dollars allocated: $48.7 million
    - Number of allocated projects: 69
    - Number of awarded projects: 7
    - Total dollars for awarded projects: $5.0 million

2.3 SB 1's Contribution to Overall Construction Market in California

BEA estimates the California GRP at $3.0 trillion in 2018 with an average annual growth rate of 5.4% since 2010 (post-recession). The construction market GRP is estimated at $111.3 billion (or about 3.7% of California's GRP) in 2018. The construction market has grown at a faster pace than California's GRP overall with an average annual growth rate of 7.7% post-recession. While construction's share of GRP has been rising since 2011, it is still below pre-recession levels. In 2005, construction accounted for 5.3% of total economic activity in California – compared to only 3.7% today.

Nonetheless, BEA's GRP data show that construction remains an important market in California. It accounts for 13.3% of total construction in the U.S and has grown at a faster pace than national construction GRP.[12] California's construction GRP is now greater than pre-recession levels, where it had peaked in 2006 at $97.8 billion (see Figure 2-4).

Construction's Share of GRP

While still making up a smaller share of GRP post-recession, California's construction market has grown faster than the rest of GRP and faster than US construction as a whole.

Construction is typically broken into two categories:

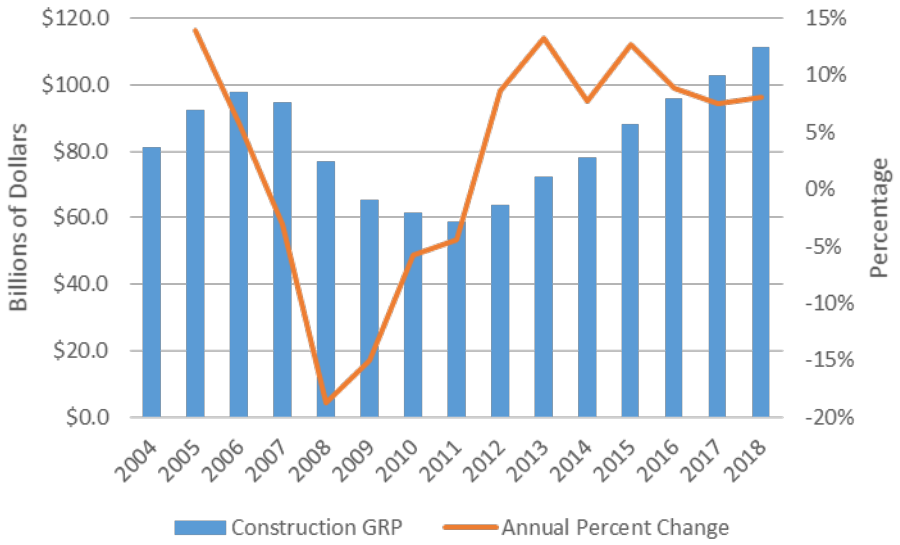
- Residential construction (e.g., single family, multifamily, and public)
- Nonresidential (e.g., private, building and heavy/civil)

Supply (employment) is also rising with demand (construction spending). Construction employment totaled 900,700 in July 2019. This represents an increase of approximately 4.3% compared to July 2018. However, total employment is still 5.0% less than in June 2006, when state construction employment peaked.[13]. According to a survey conducted by the Associated General Contractors (AGC) of America, construction unemployment is near a series low, with 68% of firms in California reporting difficulty filling hourly craft worker positions.

[12] US construction GRP in 2018 is estimated at $839.1 billion, growing at an average annual growth rate of 6.0% post-recession. California's construction GRP is estimated at $111.3 billion and has grown at an average annual growth rate of 7.7% post-recession.

[13] Associated General Contractors (AGC) of America. The Economic Impact of Construction in the United States and California. September 2019.

Figure 2-4. California Construction GRP



Source: Bureau of Economic Analysis

SB 1 will add to construction's share of the California GRP. If all of the SB-1 revenues contribute as expenditures in construction, they are equivalent to about 5.0% of the overall construction GRP.[14] However, the impact on total California's GRP will be higher as this impact ignores the multiplier effect that occurs when vendors purchase materials and services within and outside the construction industry. According to the BEA's 2018 input-output accounts, the construction industry has a total multiplier effect of about 1.93 nationally.[15] This means that expenditures in construction add roughly twice as much to California's GRP overall.

2.4 SB 1's Contribution to Construction Spending in California

HDR looked at construction spending data from the US Census Bureau.[16] In 2018, private nonresidential spending in the state totaled $31.0 billion, representing a 2.6% increase compared to 2017. State and local construction spending totaled $37.1 billion representing a 12.9% increase compared to 2017. Cumulatively, these private and governmental expenditures accounts for California construction expenditures totaling $68.1 billion, but they exclude residential construction.

[14] The share is estimated by dividing nonresidential construction GRP by SB 1 revenues. This is calculated as follows: $5.4 billion / $111.3 billion = 4.86%.

[15] US Bureau of Economic Analysis. Input-Output Industry Data. Accessed via the following link: https://apps.bea.gov/iTable/index_industry_io.cfm
Last access on December 22, 2019

[16] US Census Bureau. Construction Spending. Accessed via the following link: https://census.gov/construction/c30/historical_data.html
Last accessed on December 17, 2019

Data are not available at the state level for residential expenditures, so HDR looked at residential expenditures as a share of total construction expenditures at the national level to estimate residential expenditures in California. Taking into account residential construction in the private and public sector, we estimate that overall construction expenditures (including residential construction) in California total approximately $106.1 billion. California transportation funding accounts for approximately 27% of these expenditures.[17] Likewise, SB 1 expenditures are expected to be about 4% of total construction expenditures.[18] These shares are expected to grow over time as additional SB 1 revenues are generated and invested in projects with the objective of repairing California's infrastructure.

SB 1 as a Share of Construction Expenditures

As of the 2018-19 fiscal year, SB 1 revenues are equivalent to 4% of total construction expenditures in California.

Construction firms have yet to see the full influx of projects funded with SB 1 revenues. However, in the medium to long term, SB 1 funds will have a larger impact on construction, potentially impacting workforce availability, wages, and prices of materials. More projects will be funded with SB 1 revenues, satisfying the requests for more work made by construction firms and material vendors participating in the surveys. This is likely to attract workforce and encourage development of materials, thus making the industry more competitive in the next decade.

[17] Estimated by dividing the total California transportation revenues by total construction expenditures (i.e., $28.7 billion / $106.1 billion)

[18] Estimated by dividing SB 1 funds available in FY2018-19 by total construction expenditures (i.e., $4.5 billion / $106.1 billion)

Chapter 3. SB 1 Impact on Contractor Capacity

Over the period from 2010 to 2019, there were approximately 500 to 600 construction firms that submitted bids to the Department.[19] The Associated General Contractors (AGC) (Ken Simonson, September 17, 2019) estimates, that as of 2016, there were just over 7,000 construction firms serving all markets with at least 20 employees, and 1,089 firms with at least 100 employees. With this ample supply of construction firms, Caltrans was able to award contractors about 1,200 SHOPP and STIP projects between FY2017-18 and FY2018-19.[20]

Assuming that a firm can deliver multiple projects over a two-year period, the numbers indicate that there have been enough construction firms during the last two fiscal years to support the Department and local agencies in repairing and maintaining California's transportation network of highways and bridges. However, with the ramping-up of projects under SB 1, the Department needs to understand the contracting industry's capacity to bid the incremental volume of work anticipated in the coming years.

This chapter summarizes HDR's investigation of SB 1's effect on construction contractor competition related to the capacity to bid and deliver projects. Other areas of investigation look at ways in which the Department can attract contractors to bid on public construction projects. The key findings have been gathered across the results from surveying and interviewing construction contractors, material suppliers and producers, industry and trade associations, and government employees from Caltrans and its partners.

3.1 Key Findings

3.1.1 Results from Construction Contractor Survey

- Contractors who have provided services to the Department over the past 10 years, have the capacity[21] to bid on future projects. As of the time of the study, SB 1 has not impacted contractors' capacity to bid. Several of the participating contractors were small businesses, disadvantaged business enterprises (DBEs), or disabled veteran business enterprises (DVBEs).
- Most construction contractors who participated in the survey are involved in heavy or highway construction (75%) and paving businesses (54%).
- Most respondent firms have at least some familiarity with SB 1. Specifically, 59% of respondent firms said that they are familiar with SB 1, and 30% are somewhat familiar with SB 1.

Contractor Perspectives

Contractors have the capacity to bid on future projects. As of the study, SB 1 has not impacted contractors' capacity to bid.

[19] Contractor contact list (unduplicated) provided by Caltrans, August 19, 2019.

[20] Project award database provided by Caltrans, September 3, 2019.

[21] Contractor capacity refers to the ability of a firm to bid and win new project work and deliver on schedule and on time.

- The average (median) number of projects that construction contractors pursued was 79 projects from July 2018 to June 2019, and an average (median) of 5 of these projects were funded by SB 1.
- Although 46% of construction contractors noticed an increase in the total number of projects they pursued during the most recent fiscal year (July 2018 to June 2019) compared to the previous fiscal year (July 2017 to June 2018), 32% said that there had been no real change during that period.
    - Forty-eight percent (48%) of respondents said that the year-over-year change in the number of projects they pursued was larger than the changes observed in recent years (2013 to 2016).
- The average (median) number of projects construction contractors worked on was 25 projects from July 2018 to June 2019, and an average (median) of 3 projects were funded by SB 1.
- Although 42% of construction contractors said that the number of projects they had completed or actively worked on during the most recent fiscal year (July 2018 to June 2019) had increased since the previous fiscal year (July 2017 to June 2018), 37% stated that their workloads had not really changed.
    - Fifty-three percent (53%) of respondents said that this year-over-year change in the number of projects they worked on was larger than the changes observed in recent years (2013 to 2016).
- The majority of the firms (95%) said that they would consider bidding on future projects with funding from SB 1.
- 85% of firms are planning to expand their workforce at an average rate of 11% to 15% (median).
- Even with noted shortages of asphalt, concrete, steel, and other materials and products since 2018, 76% of construction contractors continued to bid on new projects.

3.1.2 Results from Industry and Trade Association Survey

- When asked about their members' construction outlook over the next five years, trade associations responded positively by selecting either increases in business or holding course. None of the respondents said that their members felt there would be a downturn in business. Five of the respondents attributed some or all of the positive growth to SB 1.

Positive Outlook

Trade association members have a positive construction outlook over the next five years.

3.1.3 Results from Government Staff Survey

- Over the next five years, government staff expect to work on an average (median) of 45 design-bid-build (DBB) projects per respondent's office, though the numbers range from 0 to 500 projects.

  - In comparison, over the next five years, responding government staff expect to work on an average (median) of 9 construction manager/general contractor (CMGC) projects and an average (median) of 1 design-build project.

- Nearly 53% of responding government staff said that they have not heard concerns from their contractors or consultants regarding capability to manage the increased number of infrastructure projects related to SB 1 funding. Alternatively, 29% said that they have heard concerns from their contractors or consultants.

3.1.4 Results from Focus Group Session

- Contractors are developing marketing strategies and plans for their business. Being informed as to what new projects will be let is necessary to find appropriate partners, suppliers, and skilled labor in a timely manner. The Department's 12-month and 24-month look ahead project reports will aid contractors as they develop their marketing strategies.
  - They are looking for more work now.
- Contractors and materials suppliers and producers would need to see project awards at frequencies and amounts beyond what was observed during the peak construction period of 2004-2007 before they would be concerned about reaching capacity. Doubling or tripling the current incremental increase in project numbers or award dollars could cause capacity problems.

How much is too much?

SB 1 would need to double or triple the current incremental increase before capacity problems would occur.

- Complicated specifications, regulations, and other bureaucratic impediments such as paying bills are affecting the attractiveness of projects.
  - Industry consolidation is a continuing trend that will have an impact on the number bidders, and how projects are delivered over time.

3.2 Factors That Affect Contractor Capacity

For this study, *contractor capacity* refers to the ability of a firm to bid and win new project work and deliver on schedule and on time. The notion of impediments to meeting demand is not new in diverse and active economies. With respect to the construction industry, the three main drivers of contractor capacity are: (1) the availability of construction labor, especially in the crafts trades such as cement masons and journey trades; (2) the availability of construction materials (such as aggregates, asphalt, and fly ash among others) and construction equipment (e.g., spray pavers, shuttle buggies,

What is contractor capacity?

Contractor capacity refers to the ability of a firm to bid and win new project work and deliver on schedule and on time.

electrical signs, traffic lights, etc.); and (3) transportation and freight services. These factors are explored further in Chapters 4 and 5.

This chapter emphasizes contractors' capacity based on their own statements and capabilities to pursue new contracts with the Department. Contractors' financial difficulties were out of scope for this study, but the financial performance of a company definitely has the greatest effect on a company's ability to bid, win, and deliver construction projects on time (Sweis, Sweis, Bisharat, and Bisharat, 2014).

Outside of the previously mentioned main drivers for contractor capacity, issues related to delivering and managing auctioned government projects also have a bearing on whether contractors will choose to bid on certain projects. A study by Gil and Marion (2013) explored the importance of business relationships among prime consultants and subconsultants and found that solid relationships encourage a larger number of bids and lower bids. To remain competitive outside the partnering network of relationships, firms need to have knowledge of other firms that would compete for the same projects.

Anticipating the number and identity of bidders has a significant influence on the possible outcomes for let projects, as shown in a study by Ballesteros-Pérez, Skitmore, Pellicer, and Gutiérrez-Bahamondes, (2016). When a bidder knows in advance which specific bidders are likely competitors, this knowledge gives a company strategic insight at which price to bid to meet its self-interest. As an example, a focus group participant of this study acknowledged that if his firm has a sense that there is a high number of bidders on a project and that his firm is already near capacity, they would still bid, but bid high. This finding was confirmed by participants in the study focus group. The Department can monitor the interplay of bidders over time by analyzing changes in the number of bidders and bid variability per project award. An increasing number of bidders coupled with an increasing bid variability could be a signal that the pool of qualified contractors are reaching capacity and that the release of projects should be metered.

The types of projects and award ranges also have a bearing on contractor capacity and willingness to bid. Whether firms will bid on the project auction might depend on the size or award amount for a project, as shown in a study by Drew and Skitmore (1997). The most successful construction firms are those that favor a preferred contract size range. Having a variety of let projects based on size and complexity will encourage a broader range of construction contractors to bid on Caltrans projects.

Mergers and acquisitions (M&A) continually change the competitive landscape in the construction market by reducing the pool of independent firms while increasing the suite of capabilities within the transformed firms. Fails Management Institute's 2019 report *M&A Trends for Engineering and Construction* (FMI 2019) showed evidence of a record level of mergers and acquisitions in 2018, with a 26.5% increase over the previous year.

What are the effects of increasing M&As in the construction industry?

Consolidated firms will focus on larger projects with design-build or integrated project delivery methods.

Consolidation offers benefits of addressing labor shortages, "accessing attractive regional markets, increasing capacity through vertical integration and better financing options."

Alternatively, M&As allow new players into the field. For example, the Washington Post ran a July 6, 2017 article on AECOM's $175 million purchase of Oakland, California-based Shimmick Construction. The news

story pointed out that AECOM was looking to expand capacity in preparation for increased infrastructure activity in California.[22]

3.3 SB 1's Effect on Construction Contractor Capacity - Synopsis

The total number of projects pursued and projects worked on from July 2018 to June 2019 increased compared to the total number pursued and worked on from July 2017 to June 2018. A large percentage of the firms (48%) believed that this change was larger than the observed changes in recent years (2013 to 2016). These results indicate a possible correlation for the respondents between the increase in the number of highway and bridge projects in California and the implementation of SB 1. In fact, 56% of firms familiar with SB 1 were currently planning to bid on existing SB 1 projects at the time of the survey and nearly all (95%) would consider bidding on future SB 1 projects. To maintain capacity, contractors have a strong intent to expand their workforce with 85% of the responding firms planning this. The median percentage increase in workforce across responding firms amounted to 11% to 15%. Even with perceived shortages of essential construction materials such as asphalt, concrete and steel, the majority (75%) of responding construction contractors still submitted bids on construction projects.

This high level of willingness to bid on more projects conveys a positive outlook on the capacity of contractors to bid and deliver construction services from their own perspective. The industry and trade associations who participated in the study and represent various construction industry firms felt that their members had a positive outlook on their industry's business growth over the next five years. Government staff who have contact with contractors answered the question as to whether or not their contractors voiced concerns over being able to bid on the incremental projects under SB 1. The outcome showed that less than a third (30%) of staff heard such concerns.

Similar positive sentiments were expressed in the focus group session. The group indicated that the industry has capacity to meet the forecasted demand. Firms are asking for more projects. If the industry was capable of meeting the peak demand observed during years 2004 to 2007, then it can also meet the projected demands from under SB 1 funding.

Firms are asking for more projects

Per the focus group, the industry was capable of meeting the peak demand observed during years 2004 to 2007. It can also meet the projected demands under SB 1 funding.

When asked what types of delivery methods contractors have pursued in the past, CMGC was the top pick (55%), closely followed by DBB (53%).[23] The high percentage of responses for CMGC may indicate a preference for this emerging project type. When Department and local agency transportation staff who participated in the study estimated the number of projects that would be awarded over the next five years by delivery, DBB was the method with the highest number of projects with an

[22] https://www.wsj.com/articles/aecom-to-buy-shimmick-construction-for-175-million-1499374080, accessed December 11, 2019

[23] Note that respondents could select all delivery method choices that were applicable to them, whether they were for Caltrans' projects or projects let by other agencies.

average (median) of 45 projects per respondent's office. The number of planned CMGC projects was lower with an average of only 9 (median). Having more delivery options and projects of differing sizes especially in light of increased industry consolidation through M&As, would make it more attractive for contractors to bid on Caltrans projects.

Final comments shared by contractors about how SB 1 funding could affect the construction industry in California had just over 50% of responses either not observing an impact from SB 1 funding or questioning the existence of these projects. The other half were anticipating the impacts in terms of higher costs or recognized the benefits to the economy from projects funded under SB 1.

Even government staff who work regularly with contractors seem to have conflicting comments. While one government employee offered this comment *'There are actually not enough paving jobs out there right now for the construction industry to bid and they are wondering where all the SB-1 $ are,'* another respondent made the opposite observation with this statement *'In conversations with contractors, they have said that SB1 has completely flooded the market with work and there are inadequate labor, materials, and equipment resources available leading to greatly increased construction costs'.*

These comments indicate that the effects of SB 1 are in flux, and that contractors are not in the position to accurately quantify how SB 1 has affected construction costs over and above the existing economic and industry trends. However, even with the challenges presented with the increase demand, this group sees SB 1 as an opportunity, not a problem.

Construction contractors shared ideas about how the Department can streamline the delivery of new highway and bridge repair and maintenance projects in the era of SB 1 funding to help Caltrans maintain its "client of choice" designation. They include the type of project delivery method, the size of the project award, project schedule flexibility, flexibility in materials specifications (e.g., Superpave asphalt), flexibility with sub-consultant partnering agreements (e.g., level of assigned effort from SB, DVBE, DBE firms), and reduced bureaucratic impediments (e.g., improve payment process).

Caltrans planning, cost estimation, and delivery of projects may need to change to keep its projects competitive. For example, the Department may need to take the lead in broadcasting the 12-month and 24-month look ahead reports to the pool of eligible contractors. Consistently executing planned projects within a few months of the estimated let dates will add credibility to the look ahead reports.

With respect to cost estimation, Caltrans should review how project cost risk or contingency is estimated. Typically, contingency is added in early budgeting stages as a large lump sum percentage or as the project develops, and is not project specific. However, cost estimation can be improved if contingency risks are project specific. For example, the distance aggregates need to be transported to reach a project work site has a significant bearing on the final costs and needs to be factored into early project cost estimates.

The CHCCI captures the market shifts in construction materials prices. The Department should incorporate the latest changes to the CHCCI as described in Chapter 7 of this report to make project awards competitive in a diverse construction market (i.e., municipal, non-residential private, residential, etc.). By incorporating impacts on highway

construction costs from project contingency factors and the CHCCI, Caltrans can improve its cost estimation to reflect market conditions at the time of letting, and hence provide estimates closer to bidders' estimates. Otherwise, firms may prioritize work for municipalities and private entities that are viewed as being easier to work with and offering higher profit margins.

The study results from assessing contractors' capacity to bid on the Department projects support a conclusion that SB 1's implementation since June 2017 is in a transitional phase. The full and anticipated effects of incremental demand over and above ongoing economic pressures on contractor capacity will be not be realized until more projects are let.

Chapter 4. SB 1 Impact on Demand and Supply for Materials and Products

Construction contractors, material suppliers and producers, and industry and trade associations who participated in the study were questioned through the use of surveys about the demand and supply for materials and products. The opinions of construction contractors on the level of supply differed greatly from those of material suppliers and producers. Stakeholders from the construction materials industry who were surveyed were a significant majority (nearly 80%) in their belief that there is a good supply to meet the demand for materials such as asphalt, aggregates, and concrete. In fact, many were not even observing the advertised increased in projects as of the Third Quarter 2019. Instances where these firms differed in their outlook of availability is probably symptomatic of regional disparities in materials availability or the kinds of materials. Further analysis is recommended to confirm these reasoned assumptions.

If regional differences could explain the conflicting opinions on supply, they would not explain the observations from construction contractors who participated in the study when, as a group, they were more likely to indicate material shortages or delays since 2018. Even their materials price escalation estimates into 2020 were slighter higher than what the material suppliers and producers selected on average.

Some of the study participants voiced concerns related to a lack of truck drivers and the increased costs of shipping materials greater distances between the locations of the source materials and job sites. Their concerns were corroborated with research and publications related to trucking costs' effect on the availability and pricing of construction materials and products.

Shortages in construction equipment such as specialized tools, machinery and equipment required to build, repair and rehabilitate infrastructure was explored in a news article from Equipment World (McLoud, November 7, 2018). The skilled labor shortage in the equipment manufacturing industry, coupled with rising demand for construction equipment, leads to "longer wait times for finished products."

Additionally, high tariffs for imported commodities for construction equipment, such as aluminum and steel from China, provide an incentive to source commodities domestically and contributes to longer lead times and higher costs. Finally, longer freight delivery due to a shortage of truckers further impedes supply chains of materials and heavy construction equipment, posing challenges to the US construction industry in meeting the growing demand for construction services (McLoud, November 7, 2018).

The study's participants were more likely to discuss shortages in construction materials such as asphalt or aggregates rather than construction equipment. However a few did provide examples of shortages of construction equipment, such as spray pavers, shuttle buggies, electrical signs, and traffic lights.

This chapter summarizes HDR's investigation of SB 1's impact on the demand and supply of materials and products for the highway and bridge construction industry in California. The key findings have been gathered across the results from surveying and interviewing construction contractors, material suppliers and producers, and industry and trade association representatives.

4.1 Key Findings

4.1.1 Results from Construction Contractor Surveys

Material and Product Supply

Contractors have experienced delays, shortages, and price increases.

- Construction contractors have experienced material delays and increases in prices. However, they do not see this as a direct result of SB 1, but more as a result of growing number of infrastructure projects, economic growth, and tariffs coupled with difficulties finding trucking services.
- The majority of the surveyed firms (64%) said that they had experienced shortages or delays when ordering highway or bridge construction materials since 2018. These shortages or delays did not stop the majority of the firms (76%) from bidding on projects, they but did cause schedule disruptions.
    - An increased demand due to the growing number of infrastructure projects (72%) and increased demand due to the growing economy (68%) were the reasons most selected for supply shortages or delays.
- Eighty-one percent (81%) of firms expect supply shortages or delivery delays of construction materials in the future (2019–2027). The top two materials expected to have supply shortages or delivery delays were asphalt (65%) and concrete (65%).
- Forty-two percent (42%) said that some of the future shortages and delays could be attributed to SB 1.
- None of the responding construction contractors had experienced decreases in unit costs for construction materials since 2018. Concrete (77%) and asphalt (67%) were the top two materials that experienced increases in unit costs since 2018, with average increases of 6% to 10% (median). Moreover, asphalt (71%) and concrete (71%) were also the top two materials expected to experience unit price increases next year in the range of 6% to 10%.
- Thirty-five percent (35%) of the firms that had at least some familiarity with SB 1 and noticed a price change attributed some of the changes in the unit costs of materials to SB 1.

4.1.2 Results from Material Supplier and Producer Surveys

- The effects from SB 1 as observed by materials suppliers and producers at the time of this study have been modest.
- Material suppliers and produced supplied the Department an average (median) of 75 projects during FY2018–19 per respondent's office of which only a 4 projects were funded by SB 1.
- A large share of respondents (46%) experienced no real increase in the number of projects for which they supplied materials, when compared to the number of

supplied projects during July 2017 to June 2018. Instead, almost 32% had noticed decreases.

- During July 2018 to June 2019, most firms (just over 90%) had been able to provide customers with the materials or products in the quantity requested.
- About 79% of respondents had optimistic outlooks for materials and product availability in the next five years. Moreover, 74% of respondents expected steady increases in the demand for construction materials or products over the next five years.

Suppliers and producers have a positive outlook on product availability

74% of the respondents expected a steady increase in the demand of construction materials or products over the next five years.

- Since 2018, the majority (71%) of the responding firms experienced increases in their overall unit prices, where the median price increase was about 5%. Nearly 56% said that the changes in overall unit prices were on par with what they had observed in recent years.
- Half (50%) of respondents attributed next year's possible unit price increases of approximately 5% for their materials or products to higher demand due to a growing economy. Other notable reasons offered were increased demand due to the growing number of infrastructure projects (43%) and truck driver shortages (43%).
- Only some of the prices changes could be attributed to SB 1 as indicated by 40% of firms. The remaining respondents either could not comment or felt SB 1 had no impact
- Material suppliers and producers who participated in the study had mixed outlooks on product availability. Still, the majority or 79% had a growth or holding steady perspective while the rest felt shortages are looming.

4.1.3 Results from Trade and Industry Associations Survey

- The responding associations had mixed opinions on whether or not their members have had difficulties supplying their customers with construction materials/products since 2018. For those that said their members were having difficulties supplying materials, the materials in question were aggregates, asphalt binder, and concrete.
- Reasons for lack of materials availability were shortages of truck drivers, market forces, industry consolidation, permitting, unreasonable regulations, and other bureaucratic impediments.
- Associations indicated their members were raising prices by 2% to 5% next year.

4.1.4 Results from Focus Group

- The focus group participants were optimistic as to the demand and availability of construction materials and products. During the peak construction period of 2004-2007, material suppliers and producers were able to meet the demand from

that period and should future annual award totals reach those previous levels, they are still able to fulfill demand.

- Availability of fly-ash: “One of the sources in the state of California is closing down. There may be a shortage of fly-ash in the future, as coal plants keep closing down. Fly-ash producers will give priority to the Department projects, since they are [a] big client.”
- Regulation regarding asphalt production: One participant said that new regulations are making the production of asphalt more difficult.
- Concern regarding truck drivers: Participants were concerned about the lack of truck drivers. One participant said that California Assembly Bill 5 (AB 5), which will go into effect on January 1, 2020, will affect independent truck drivers.[24]

4.2 Factors That Impact Availability and Prices

Availability and prices for essential construction materials, products and equipment are functions of demand, labor costs, transportation costs and, to a lesser effect, tariffs. California is host to an ample supply of raw and processed highway construction materials such as aggregates, asphalt, cement, and concrete used in the construction of highway and bridges. Steel is manufactured in California, but raw materials are imported from other countries.

Forty-three percent (43%) of the aggregate produced in California goes to public infrastructure projects, which includes 26% of aggregate that goes to public highways, streets, and transit. (California Department of Transportation, March 2018). The yearly demand for aggregates in California is estimated to be 2.2 million tons (Ghilotti, 2018). Demand for aggregate is expected to increase as the state’s population continues to grow and infrastructure is maintained, improved or expanded. A recent study by the California Geological Survey (2018) found that the permitted aggregate reserves fall drastically short of the 50-year demand forecast with one aggregate study area projected to have 10 or fewer years of permitted aggregate reserves remaining as of January 2017.

Some materials, such as fly ash, have dwindling reserves because coal is not burned for energy and coal plants are being decommissioned. In addition to the essential components of highways and bridges are the specialized tools, machinery and equipment required to build, repair and rehabilitate massive infrastructure assets. A news article from Equipment World (McLoud, November 7, 2018) explored the issues related to availability of equipment. The skilled labor shortage in the equipment manufacturing industry, coupled with rising demand for construction equipment, leads to “longer wait times for finished products.”

[24] AB 5 is intended to protect workers employed in the so-called “gig” economy, such as with ridesharing companies Uber and Lyft. The bill addresses the misclassification of drivers as independent contractors rather than employees. But it will make it extremely difficult for firms and trucking companies from hiring independent truck drivers due to the new classification of independent drivers. The bill will interrupt the long-standing good working relationship between trucking companies and independent truck drivers.

Additionally, high tariffs for imported commodities for construction equipment, such as aluminum and steel from China, provide an incentive to source commodities domestically and contributes to longer lead times and higher costs. Finally, longer freight delivery due to a shortage of truckers further impedes supply chains of materials and heavy construction equipment, posing challenges to the US construction industry in meeting the growing demand for construction services (McLoud, November 7, 2018).

Issues to transporting construction materials are addressed in the Caltrans memorandum "2018 Aggregate Resource Policy Statement and Tools." This document notes that the shipping cost of aggregates can outweigh the cost of production if the aggregate is transported more than 20 miles. A study by Ghilotti, (2018), "Rail Transportation of Aggregate Material" looked at when freight becomes more cost-effective over trucking in transporting aggregates, specifically in the North Bay Area.[25] The study noted that there is regional disparity in the 50-year supply of permitted aggregates. Depending on where the locations of a project and the permitted material, the "cost of transportation quickly exceed the value of the material." The study was cognizant of the potential for higher demand for construction materials due to SB 1 and coupled with the continued construction growth, increased trucking cost, and an environmental aversion to new quarry permits, the study anticipated an acceleration of the aggregate shortage in the North Bay Area.

4.3 SB 1's Effects on Demand and Supply for Materials and Products - Synopsis

The majority of construction contractors (64%) have experienced shortages or delays in construction materials since 2018. The majority (72%) of the firms said that these shortages or delays might have been driven by the increased demand due to the growing number of infrastructure projects. Despite the shortages or delays, the bidding decision by most firms (76%) was not affected, but they did disrupt project schedules for nearly all of the firms (96%). Forty-two percent (42%) of the respondents who were at least somewhat familiar with SB 1 attributed some of the shortages or delays to SB 1.

California's permitted aggregate reserves fall drastically short of the 50-year demand forecast.

Demand for aggregate is expected to increase as the state's population continues to grow and infrastructure is maintained, improved, expanded. (CGS, 2018)

When responding contractors were asked why various products or materials are expected to be in short supply or could experience delivery delays, one respondent said that the costs of materials have gone up and that government agencies are not taking this into account in their estimates, causing delayed deliveries. In particular, this respondent stated:

> *I did not select steel because we're not having a shortage – we're just paying more due to demand and tariffs. That means everyone's estimates will be higher in the future. Half of our bids this summer were sent to rebid because*

[25] Represented by counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma.

no one bid at or below the engineer's estimate and I don't see agencies taking these changes into account yet.

The unit costs of most construction materials have increased since 2018. Asphalt (67%) and concrete (67%) were the materials for which most firms experienced unit cost increases, with a median price increase range of 6% to 10%. Steel experienced a median increase since 2018 in the 11% to 15% range. Construction contractors anticipate the cost of construction materials to increase in the next year on average 6% to 10%. One firm said that the "increase volume of work will drive prices higher as the margins will likely increase." Although most respondents (35%) attributed only some of the anticipated price increases to SB 1, 29% believed that SB 1 has had no effect, and another 29% were uncertain about the effects SB 1 has had on the unit costs of most construction materials.

Although the plurality material suppliers and producers who participated in the study said that the total number of projects for which they supplied materials during July 2018 to June 2019 was comparable to the number of supplied projects from July 2017 to June 2018, only 23% said that they experienced an increase in the total number of projects. Moreover, when asked how this change compared to the changes in recent years (2013 to 2016), 48% of respondents said that the change was larger. These survey results do indicate a 'business as usual' status for material suppliers and producers which is in contrast to construction contractors' statements that suppliers could struggled to meet their construction demands on schedule. In fact, material suppliers and producers felt, with a 90% agreement rate, that they could supply their clients with the materials requested in the quantity demanded during FY2018-19.

The disparity in availability levels of essential construction materials between construction contractors and materials suppliers and producers may lie in how availability is defined. A deeper dive in the comments from construction contractors did see a recognition that with planning and better organization, materials could be delivered in a timely manner in the quantity required.

Disparity in Views

Although the majority of construction contractors have experienced shortages or delays in construction materials, suppliers and producers indicate a 'business as usual' status.

Contractors recognize that materials could be available as required with better planning and organization.

Material suppliers and producers stated that overall prices of materials or products experienced an increase since 2018, and the majority of such firms (71%) expect prices of materials or products to increase into the next year by approximately 5%. This is a slightly lower value that what construction contractors shared with the study. Responding material suppliers and producers suggested that the main drivers were increased demand due to a growing economy, and more infrastructure projects, as well as a shortage in truck drivers. As with construction contractors, material suppliers and producers were not sure or did not think SB 1 had contributed to the materials price increases. Only 40% thought that SB 1 had *some* impact. The rest either did not know or could not answer.

These observations suggest that the materials suppliers or producers who participated in the study have not experienced notable increases in the number of projects they supply since SB 1 was implemented. In addition, materials suppliers and producers have a

positive outlook for product availability over the next five years and expect a steady increase in product demand over the next five years. Focus group participants voiced strong opinions that the materials industry is ready to meet the anticipated demand from projects under SB 1.

The results support a conclusion that SB 1's implementation since June 2017 is in a transitional phase, and, until more SB 1–funded projects are let, the full and anticipated effects of increased demand will not be realized. Currently, there are harbingers of road blocks to accessing sufficient materials on an affordable and timely basis depending on the location and nature of the project, independent of the impacts from SB 1 funding. With careful planning and partnership among Caltrans, construction contractors, material suppliers and producers, and trade and industry associations, the impacts from future, growing demand on material cost escalation and availability can be anticipated and managed.

Chapter 5. SB 1 Impact on Availability of Construction Labor Skills and Wages

Shortages of labor in the construction and trucking industries have been well documented in academic and agency reports for California and the US. HDR collected 28 reports or articles on that subject matter alone (see the annotated bibliography in Appendix F). Labor shortages have also been tracked by BLS prior to and since the implementation of SB 1. This chapter focuses on labor availability, while workforce dynamics within the Department are addressed in Chapter 7.

Based on the survey results for construction contractors as well as industry and trade associations, shortages of general and skilled labor and rising wages continue to be a significant issue for the construction industry. HDR observed that construction contractors who participated in the study readily wrote down comments about why they thought there were labor shortages. At least a third took the time to express themselves, which denotes a high level of frustration in finding and affording the right construction workers. While contractors were almost unanimous in labor shortages and increasing wages, less than a quarter thought only *some* of the labor issues could be attributed to SB 1, the rest did not think so or were not sure.

Study participants voiced concerns related to a shortage of truck drivers and the increased costs of shipping materials greater distances between the job site and the location of the source materials. Shortages of truck drivers was often cited as a reason for the unavailability or delays of construction materials. Their concerns were corroborated with research and publications related to trucking costs' impact on the availability and pricing of construction materials and products.

This chapter summarizes HDR's investigation of SB 1's impact on labor shortages and increasing wages in the construction industry as it related to the construction of highways and bridges in California. The key findings have been gathered across the results from surveying and interviewing construction contractors, material suppliers and producers, and industry and trade association representatives.

5.1 Key Findings

5.1.1 Results from Construction Contractor Surveys

- Construction contractors continue to see significant shortages of skilled labor in the heavy construction industry (as of the mid-2019), specifically in the construction and extraction occupations. However, they feel the shortages are due primarily to changing demographics and career preferences rather than to SB 1.
    - Twenty-one percent (21%) attributed only some impact from SB 1 on labor shortages.

SB 1 would compound existing shortages of skilled labor

As of mid-2019, construction contractors continue to see significant shortages of skilled labor in the heavy construction industry.

- Competitive forces related to increased demand for infrastructure projects (72%) and growing economy (68%) were cited as the top two reasons for labor shortages. Written comments in response to the most important factors related to labor shortages emphasized how it had become extremely difficult to find the right skillsets, especially at the journey level.
- Eighty-five percent (85%) of responding contractors plan to expand their workforce in the next five years.
- Construction contractors anticipate growing their construction and extraction staff by 16% to 20%, and management and transportation and material moving occupations (each by 6% to 10%), over the next five years to meet forecasted demand.
- Thirty-six percent (36%) of contractors voiced concerns about the current shortage of truck drivers causing delays in project schedules or material deliveries.
- The construction industry is currently paying high wages, even higher than scale at times, due to labor and skills shortages.
    - The median wage increase was 4% since last year.
    - Only 26% of respondents said that SB 1 had some effects on the wage changes. The rest said no effect (36%) or were unsure (33%).

5.1.2 Results from Material Supplier and Producer Surveys

- Forty-three percent (43%) of material suppliers and producers listed shortage of truck drivers as a contributing reason for price increases next year.

5.1.3 Results from Industry and Trade Association Surveys

- Respondents from the three associations that represent trucking firms shared differing viewpoints as to whether their members have had difficulties meeting the demand for trucking or freight services since 2018. Two respondents said that their members had not experienced difficulties, while the other one was unsure.

Lack of Truck Drivers

Contractors, suppliers, and industry associations all express concerns about the shortage in truck drivers. AB 5 may have the unintended effect of exacerbating this shortage.

- One respondent said that their members will increase their shipping costs (in this case, by 4%), and that some of the shipping cost increase could be attributed to SB 1. The other two respondents were unsure.

5.1.4 Results from Focus Group Session

- Participants were concerned about the lack of truck drivers. One participant said that California AB 5, which will go into effect on January 1, 2020, will affect independent

truck drivers. AB 5 is intended to protect workers employed in the so-called "gig"[26] economy, such as with ridesharing companies Uber and Lyft. The bill addresses the misclassification of drivers as independent contractors rather than employees. However, it will make it extremely difficult for firms and trucking companies to hire independent truck drivers due to their new classification.

5.1.5 Results from the Occupational Employment Statistics Analysis for California's Heavy and Civil Engineering Industry

- The median hourly wages for construction and extraction occupations in the heavy and civil engineering industry in California have experienced a decreasing trend, notably since 2017. Mean hourly wages show no statistically significant trend, and total employment has experienced a gradual increase over the entire 2012-2018 period.
- The median and mean hourly wages for transportation and material-moving occupations in the heavy and civil engineering industry in California have remained fairly stable and total employment has seen a general increasing trend over the 2012-2018 period.
- California's median hourly wage in 2018 for construction and extraction occupations at $29.22/hr. is 32% higher than national average ($22.07/hr.).

5.1.6 Results from the Analysis of Department of Industrial Relations Highway Construction Wage Data

- Total hourly wages have generally increased since 2012. Most of the occupations experienced a statistically significant increase of total hourly wages during 2012 to 2019. However, real total hourly wages for the majority of occupations related to highway and bridge construction have been decreasing or not changed since the implementation of SB 1 in 2017.

5.2 Factors That Impact Labor Skills Availability and Wages

The construction industry in the US contributed 4.1% towards the total US GDP in 2018 (Simonson, September 17, 2019). The construction industry within California is not far behind the national levels at 3.8% of California's GRP. Behind the weight of the construction industry's influence on the US GDP and California GRP, is a sense of uncertainty when searching for people with the right skill sets for construction projects, including Caltrans projects. Underlying the challenges on finding essential skills sets is the battle to attract employees in sufficient numbers with competitive wages and benefits.

HDR's review of studies on construction labor shortages found common themes related to issues with retirement rates, turnover rates, and younger generations not considering construction as a viable career choice. A study by McDermott, (2009) noted negative perceptions that lead to a low replenishment rate of workers that cannot outweigh the

[26] The "gig" economy is defined as a labor market characterized by the prevalence of short-term contracts or freelance work as opposed to permanent jobs.

retirement rates. Older, skilled construction workers are more likely to retire rather than continue working in physically intense occupations. This results in a decreased availability of trade workers that require more training, such as plumbers, electricians, carpenters, as well as in labor-intensive trades like iron and concrete workers. In an effort to recruit more young people into the trade and reverse the trend in negative perceptions of the industry, the State of California is spending $200 million to improve access to vocational trades and promote them as lucrative career choices.[27]

The construction industry is known for high turnover rates given the sometimes seasonal and cyclical nature of the business, and competition for workers among firms. A literature review by Bilau, Ajagbe, Sholanke, and Sani, (2015) regarding the impacts of employee turnover in construction industries focused on the following areas of impact: incurred cost, decreased job performance, cost of recruitment and training, lower knowledge base, and accident-prone employees. The findings suggest that effective methods to reduce employee turnover are employee training, mentoring programs, effective feedback, positive work culture, effective leadership, fringe benefits, and recruiting from within the organization.

There is ample opportunity for work in the California construction industry and attractive wages averaging $70,084 in 2018, 3% more than the state average for all private-sector employees. However, 68% of construction firms had difficulty filling hourly craft worker positions in California (Simonson, September 17, 2019). The shortages of skilled labor impacts project performance as measured by productivity and schedule according to Karimi, Taylor, and Goodrum, (2017). The group found that projects experiencing craft shortages underwent substantial reductions in productivity and increase in schedule overruns. Similar relationships were shown between increased difficulty in recruitment and worsened productivity or schedule results.

Wages continue to increase at the 4% level between 2018 and 2019 in efforts to retain existing construction workers and recruit new talent as reported by Buckley (July 2019). This author's study gives an overview of salary forecasts for 2019 based on industry surveys, with a higher-than-average pay increase due to growing demand and skilled labor shortage. The author also examines how work-life balance benefits may be used as a substitute for some wage increases.

Shortages of labor in the trucking industry directly impacts construction industry's performance and delivery of buildings and infrastructure. The trucking industry has been struggling to recruit, train and retain people to transport the materials essential for construction projects. A study by Costello and Suarez (October 2015) sponsored by the American Trucking Association estimated as of 2014, the shortage of drivers in the trucking industry across the US was 38,000. In 2024, it is forecasted to increase to almost 175,000. Moreover, finding adequately qualified truck drivers is increasingly difficult as industry standards of professionalism and safety become more rigorous.

Shortages of labor and skills in the construction and trucking industries is not a new phenomenon. These industries have struggled in recent times to attract new recruits even with the increasing demand for transportation infrastructure in California. SB 1

[27] https://hechingerreport.org/after-decades-of-pushing-bachelors-degrees-u-s-needs-more-tradespeople/, accessed December 13, 2019

funding will add to that demand. While this incremental demand may squeeze some construction markets in California for a period of time, eventually, people will go to where the jobs are.

In 2006, total construction employment in California peaked at approximately 946,300 before dropping during the recession era of 2008-2009. While gradually increasing over the last few years, employment is still lower today than the peak observed in 2006. The AGC stated that total construction employment was 861,100 in February 2019, still 9% lower than in 2006 (Simonson, September 17, 2019). With good marketing and training for career choices in the construction industry, the employment required to meet the incremental demand from SB 1 is possible. The State of California is doing just that and is spending $200 million to improve access to vocational trades and promote them as lucrative career choices.[28]

5.3 Results from the Analysis of Occupational Employment Statistics for California's Heavy and Civil Engineering Industry

Wage and Employment Impacts

BLS data from 2012 to 2018 do not show impacts due to SB 1. More time is needed to track the incremental impacts.

HDR tried to identify trends in employment and wages in California construction and its subcategories using BLS data (in 2018 dollars) from 2012 to 2018. The intent was to review recent trends and determine whether early signs of SB 1's impact on construction wages and employment numbers are visible. HDR used multiple linear regression methods to test if the trends from 2012 to 2018 were increasing, decreasing or no trend was discernable. In summary, we did not find notable signals from the wage trends that could be attributed to factors such as the release of SB 1 funds into the market commencing July 2017.

The lack of a positive wage trend overall and since 2017 specifically for the construction and extraction occupations within the heavy and civil engineering industry in California does not support the assumption that SB 1 has impacted wages and employment numbers as of 2018. More time and data are required to track the incremental impacts from SB 1 funding on wages and employment. Construction and extraction occupations across all industries and for heavy and civil engineering industries in California have gradually increased since 2012 as with employment trends for transportation and material-moving occupations.

5.3.1 Total Employment and Wages: Construction and Extraction Occupations

- In the heavy and civil engineering industry in California, the median hourly wages have experienced a decreasing trend, notably since 2017. Mean hourly wages

[28] https://hechingerreport.org/after-decades-of-pushing-bachelors-degrees-u-s-needs-more-tradespeople/, accessed December 13, 2019

show no statistically significant trend, and total employment has experienced a gradual increase over the entire 2012-2018 period (Figure 5-1).

- In the heavy and civil engineering industry in the US at large, wages have seen some fluctuations over a generally increasing trend, and employment has increased consistently (Figure 5-2).
- Among all construction and extraction occupations across all industries in California, the mean and median wages have remained fairly stable, but total employment has seen a consistent increase (Figure 5-3).
- For all construction and extraction occupations in the US at large, mean and median hourly wages and total employment have increased over from 2012 to 2018 (Figure 5-4).

5.3.2 Total Employment and Wages: Transportation and Material-Moving Occupations

- In the heavy and civil engineering industry in California, both mean and median hourly wages have remained fairly stable. Total employment has seen a generally increasing trend over the 2012-2018 period (Figure 5-5).
- In the heavy and civil engineering industry in the US at large, the mean hourly wage shows no discernible trend based on statistical trend tests. The median hourly wage shows an increasing trend over the 2012-2018 period. However, since 2016, both mean and median hourly wage show marked decreases. Over the 2014-2018 period, employment has increased (Figure 5-6).
- Among all transportation and material-moving occupations across all industries in California, the mean and median wages have remained fairly stable, but total employment has seen a consistent increase (Figure 5-7).

5.3.3 Total Employment Trends Details

- Total employment in the heavy and civil engineering industry, as well as that of all construction occupations, has increased in both California and the US between 2012 and 2018 (Figure 5-8 and Figure 5-9)
- Among the major occupation types within the construction occupation and the heavy and civil engineering industry in California, the following trends are shown (Figure 5-10):
    - Architecture and engineering occupations: increasing, notably since 2016
    - Business and financial operations occupations: increasing
    - Construction and extraction occupations: increasing
    - Installation, maintenance, and repair occupations: no discernible trend (marked decrease between 2016 and 2018)
    - Management occupations: increasing
    - Production occupations: no discernible trend (slight increase between 2016 and 2018)
    - Transportation and material-moving occupations: increasing.

5.3.4 Median Hourly Wages

- Median hourly wages in the heavy and civil engineering industry in California have decreased between 2012 and 2018 and increased in the US at large over this same period. Median hourly wages in all construction occupations are fairly stable in both California and the US between 2014 and 2018 (Figure 5-11)
- Among the major occupation types within the construction occupation and the heavy and civil engineering industry in California, the following trends are shown (Figure 5-12):
  - Architecture and engineering occupations: no discernible trend (decreasing since 2016)
  - Business and financial operations occupations: no discernible trend
  - Construction and extraction occupations: decreasing
  - Installation, maintenance, and repair occupations: decreasing
  - Management occupations: decreasing (fairly stable since 2016)
  - Production occupations: decreasing (fairly stable since 2016)
  - Transportation and material-moving occupations: no discernible trend (slight increase since 2016).
- Among the major occupation types within the construction occupation and the heavy and civil engineering industry in the US at large, the following trends are shown (Figure 5-13):
  - Architecture and engineering occupations: no discernible trend (decreasing since 2016)
  - Business and financial operations occupations: no discernible trend
  - Construction and extraction occupations: no discernible trend
  - Installation, maintenance, and repair occupations: no discernible trend
  - Management occupations: increasing
  - Production occupations: increasing (notably since 2016)
  - Transportation and material-moving occupations: increasing

5.3.5 Mean Hourly Wages

- Mean hourly wages in the heavy and civil engineering industry in California have shown no general trend from 2012 to 2018, but they have decreased since 2016. Wages have increased in the US at large over this same period. Mean hourly wages in all construction occupations are fairly stable in both California and the US between 2014 and 2018 (Figure 5-14).
- Among the major occupation types within the construction occupation and the heavy and civil engineering industry in California, the following trends are shown (Figure 5-15):
  - Architecture and engineering occupations: no discernible trend (decreasing since 2016)
  - Business and financial operations occupations: no discernible trend (increasing since 2016)
  - Construction and extraction occupations: no discernible trend
  - Installation, maintenance, and repair occupations: decreasing
  - Management occupations: decreasing
  - Production occupations: decreasing
  - Transportation and material-moving occupations: no discernible trend.

Figure 5-1. California Construction and Extraction Occupations in Heavy and Civil Engineering Industry

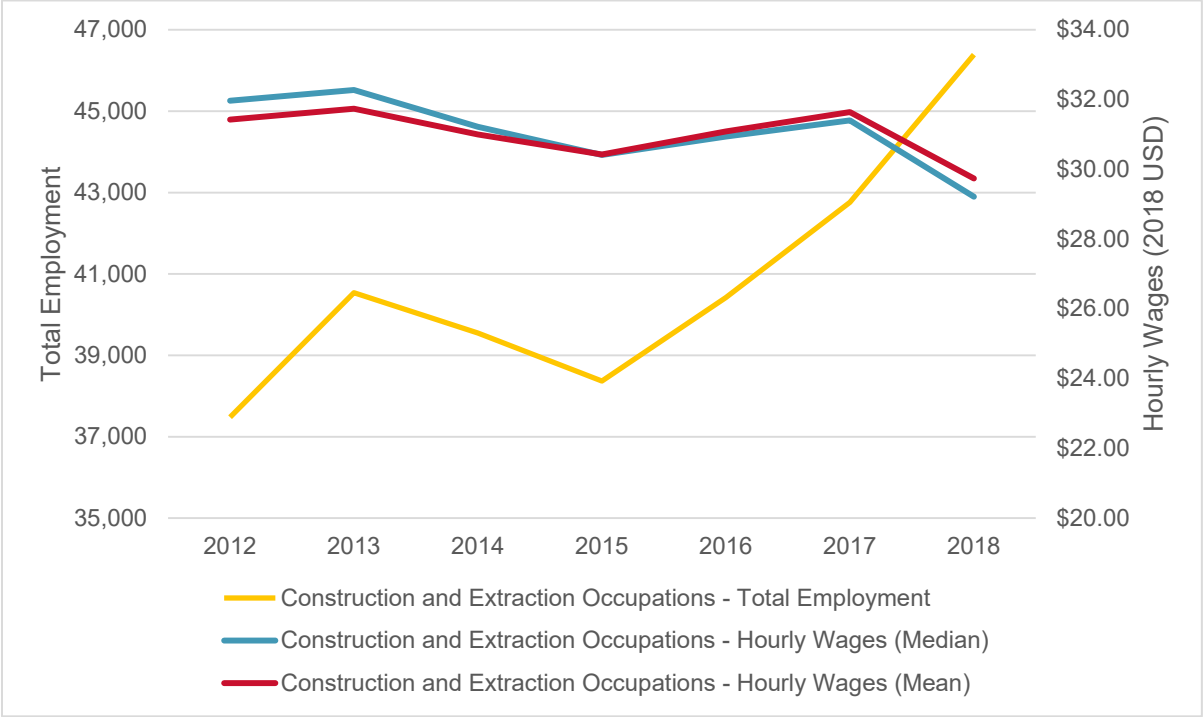


Figure 5-2. US Construction and Extraction in Heavy and Civil Engineering Industry

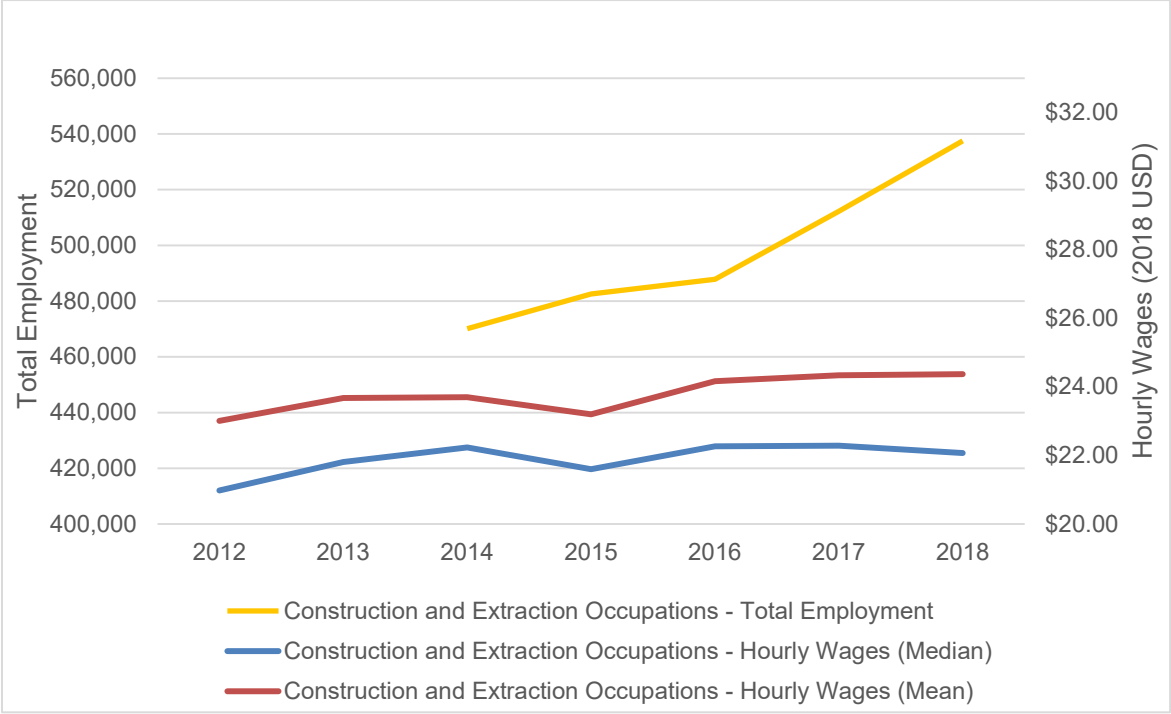


Figure 5-3. California Construction and Extraction Occupations in All Industries

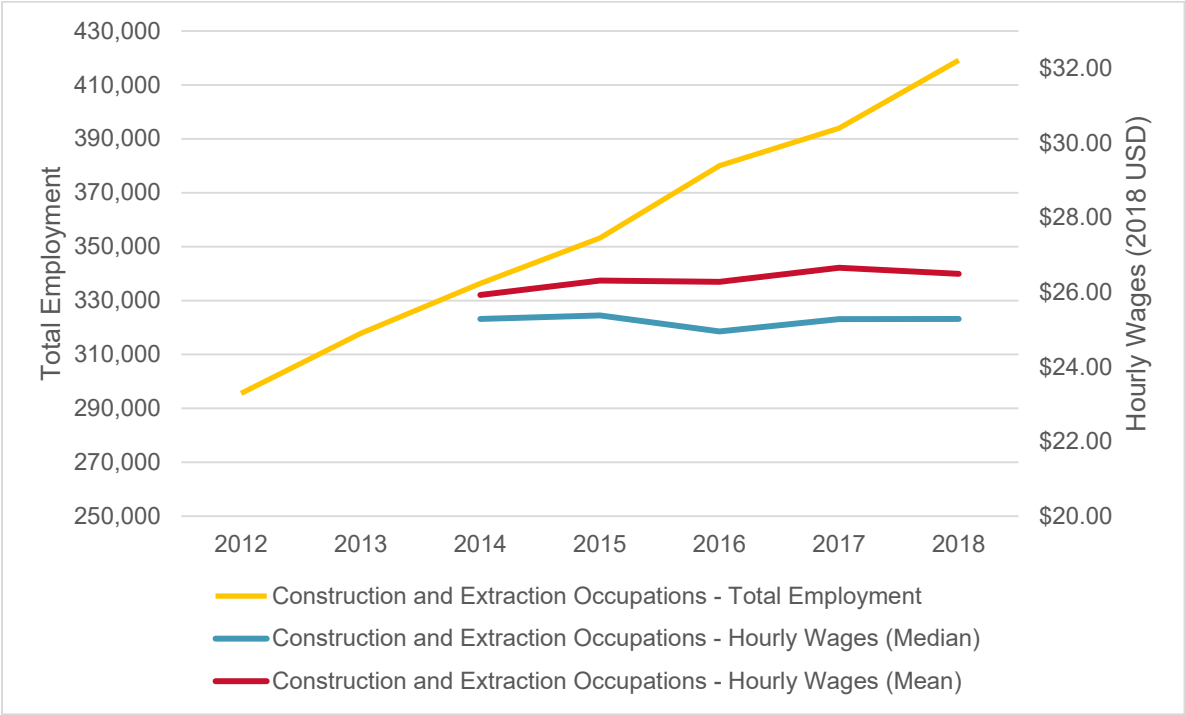


Figure 5-4. US Construction and Extraction in All Industries

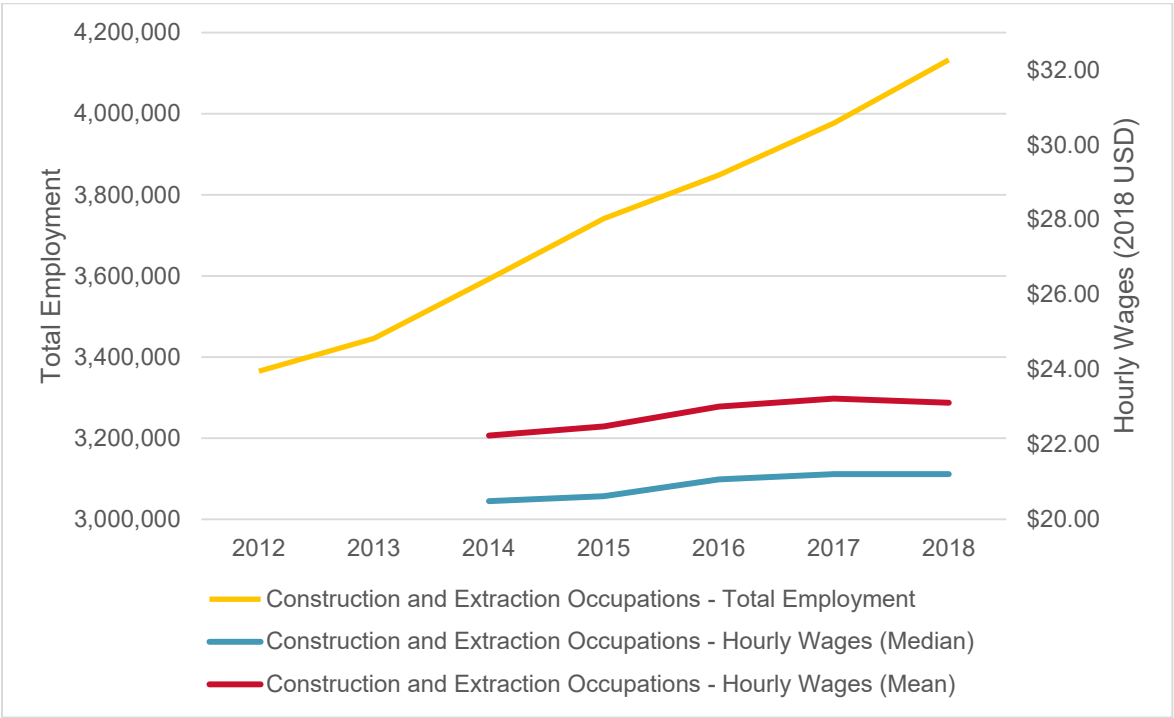


Figure 5-5. California Transportation and Material Moving Occupations in Heavy and Civil Engineering Industry

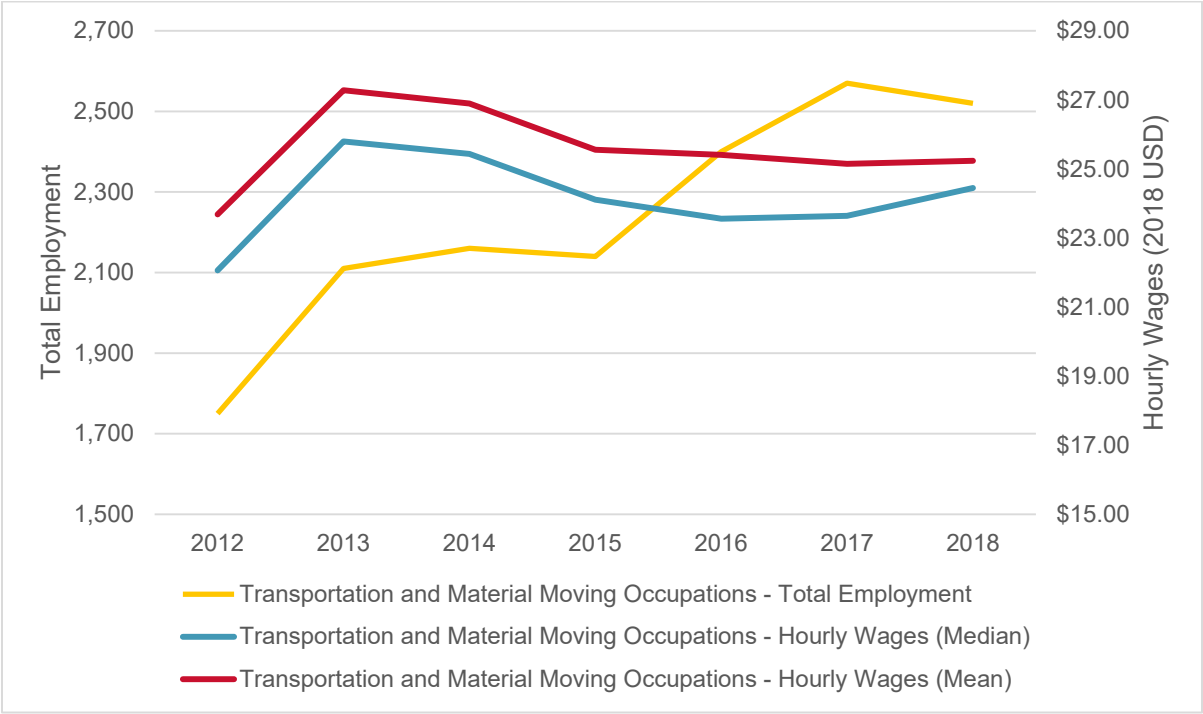


Figure 5-6. US Transportation and Material Moving Occupations in Heavy and Civil Engineering Industry

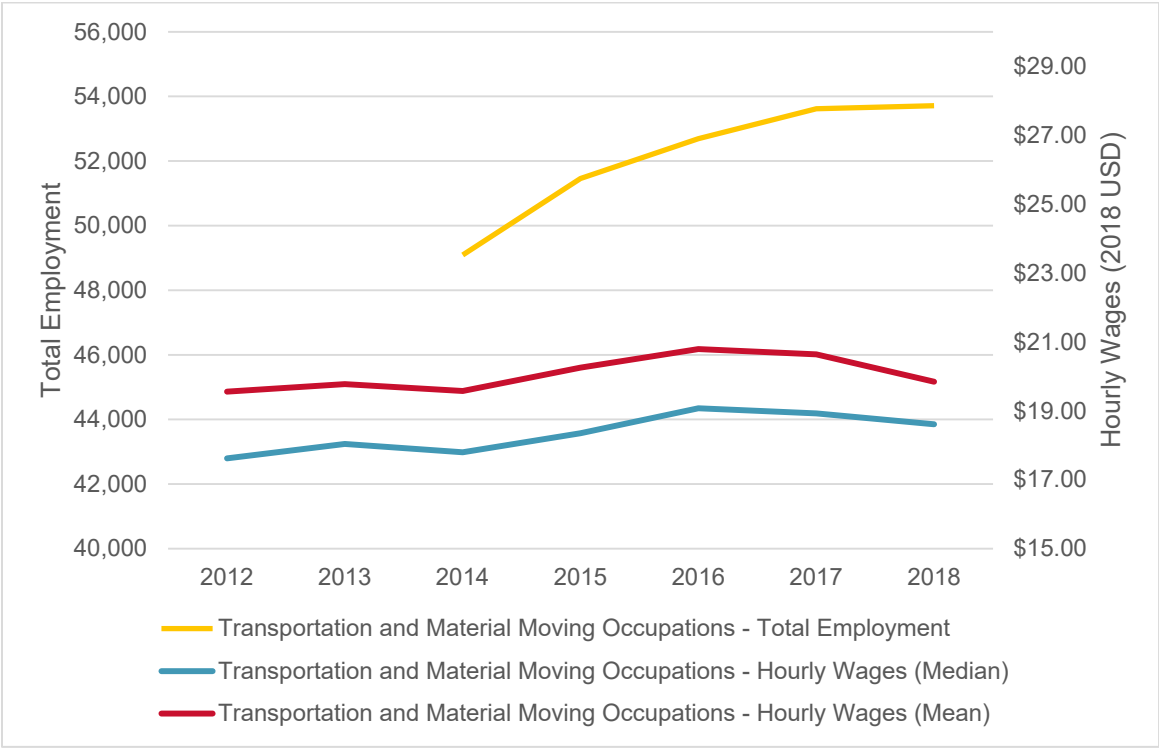


Figure 5-7. California Transportation and Material Moving Occupations in All Industries

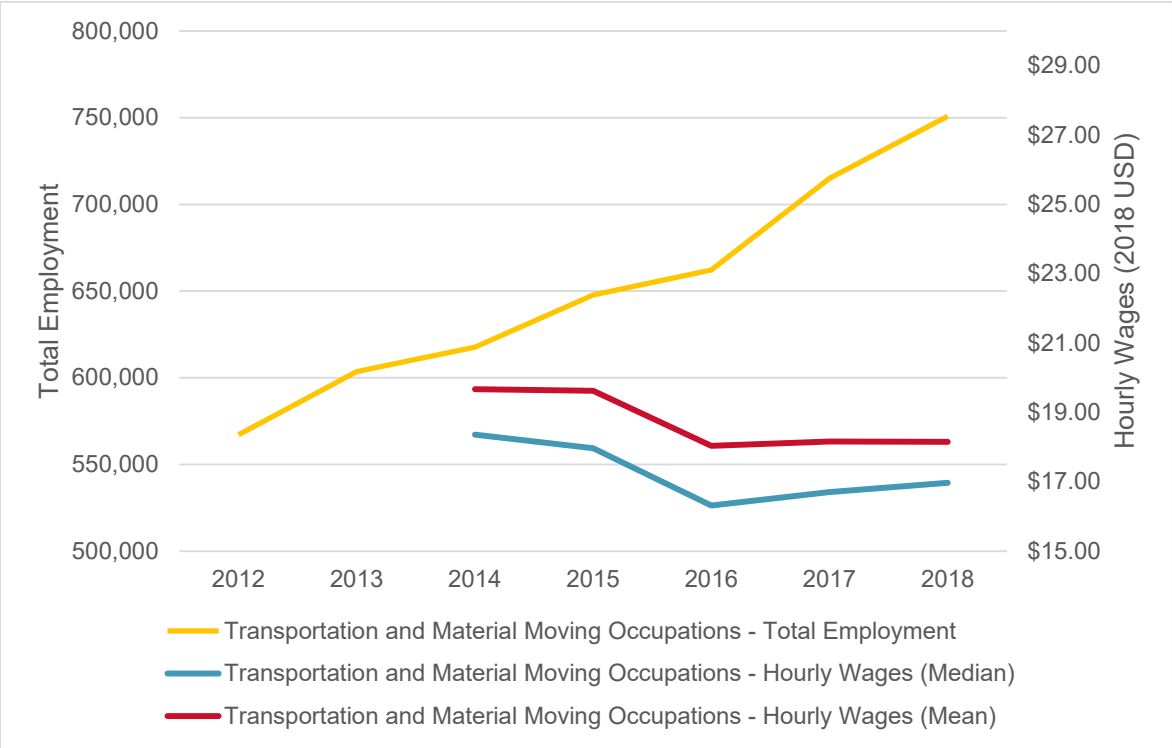


Figure 5-8. California Total Employment in Construction Occupations

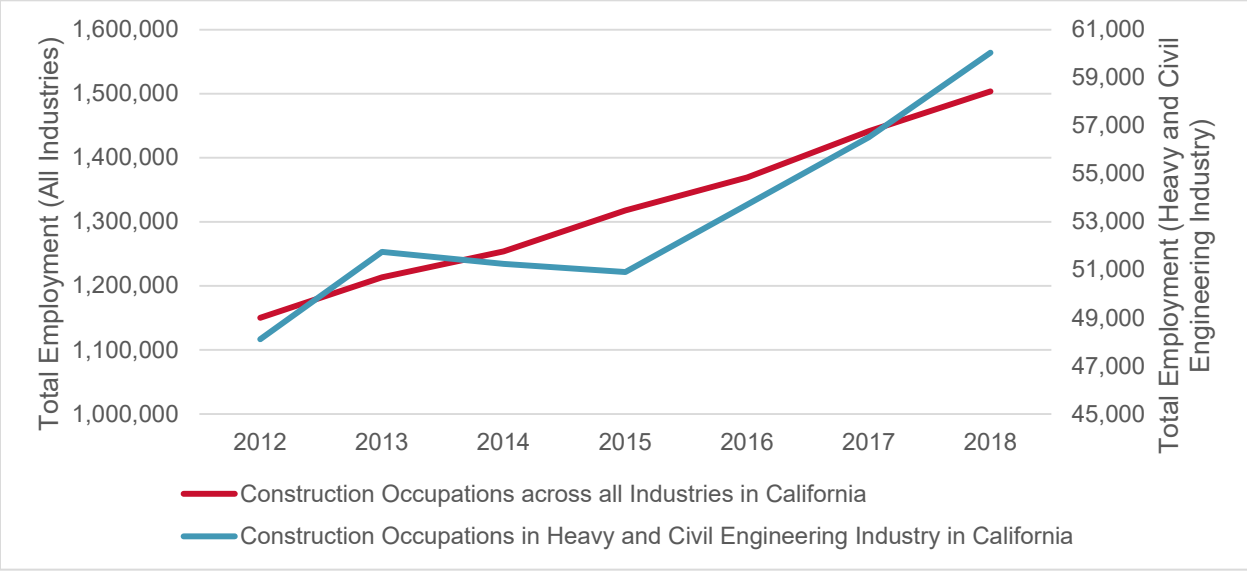


Figure 5-9. US Total Employment in Construction Occupations

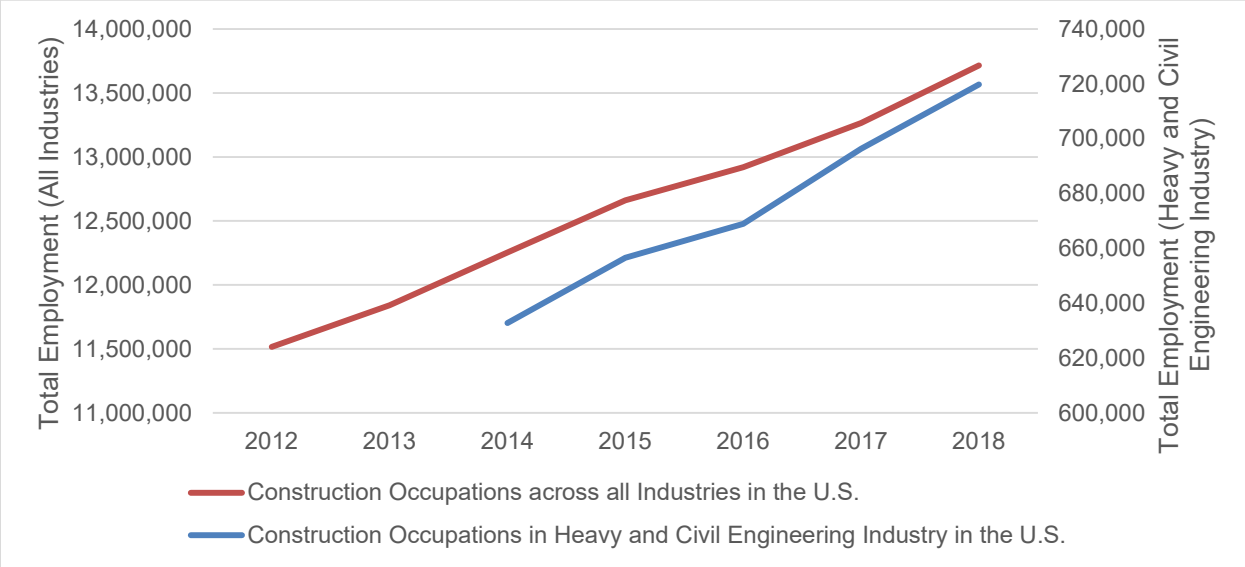


Figure 5-10. California Total Employment by Major Construction Occupation Type in the Heavy and Civil Engineering Industry

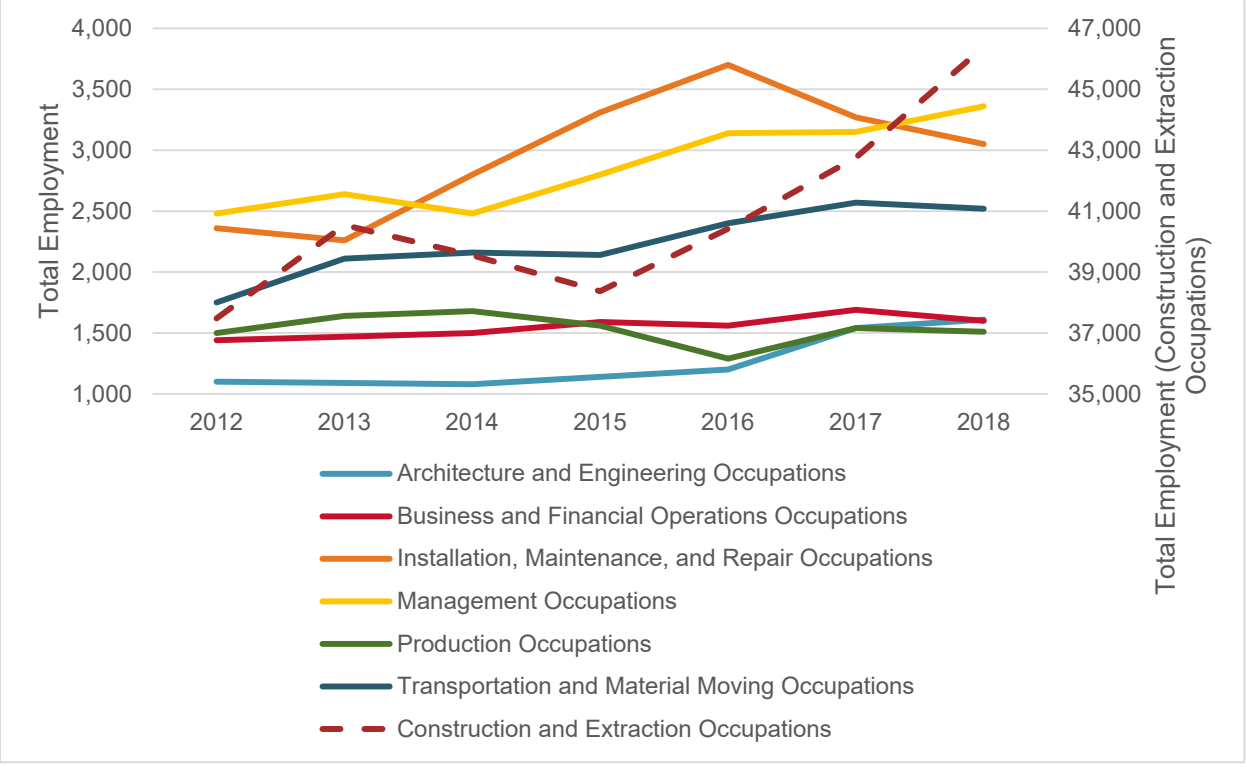


Figure 5-11. Comparison of Hourly Wages (Median) Across Jurisdictions and Industries

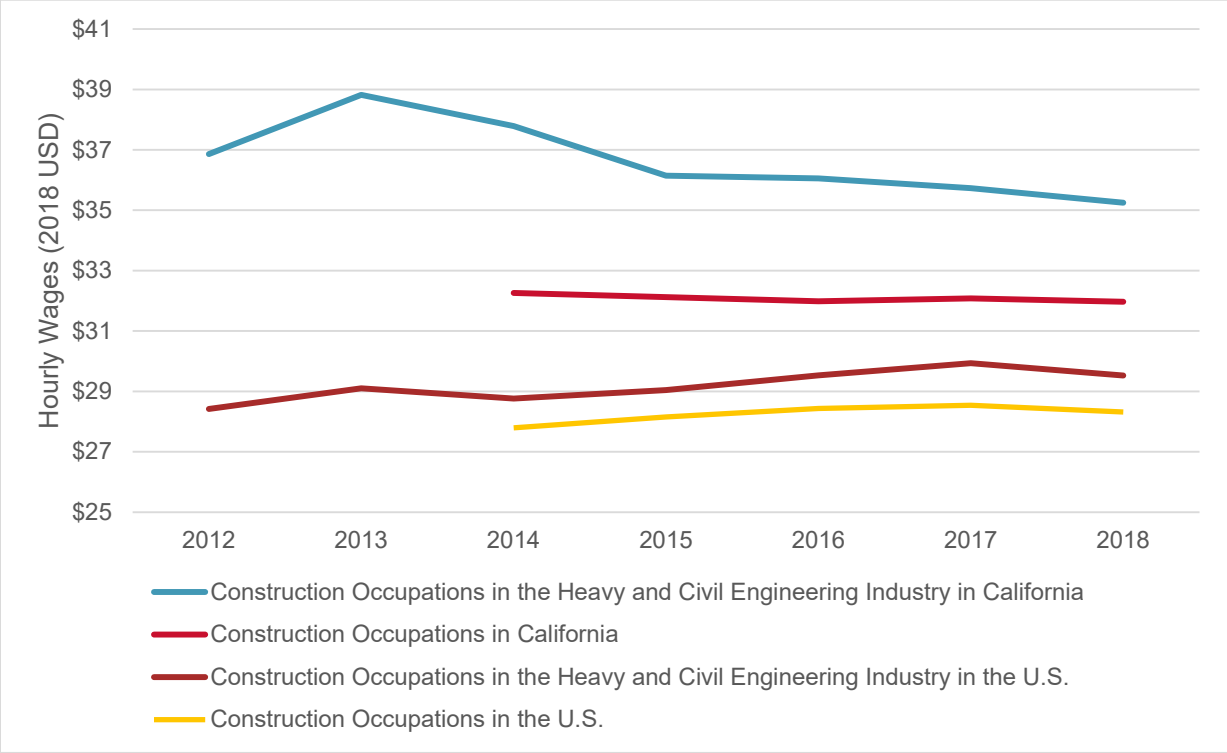


Figure 5-12. California Hourly Wages (Median) by Major Construction Occupation Type in the Heavy and Civil Engineering Industry

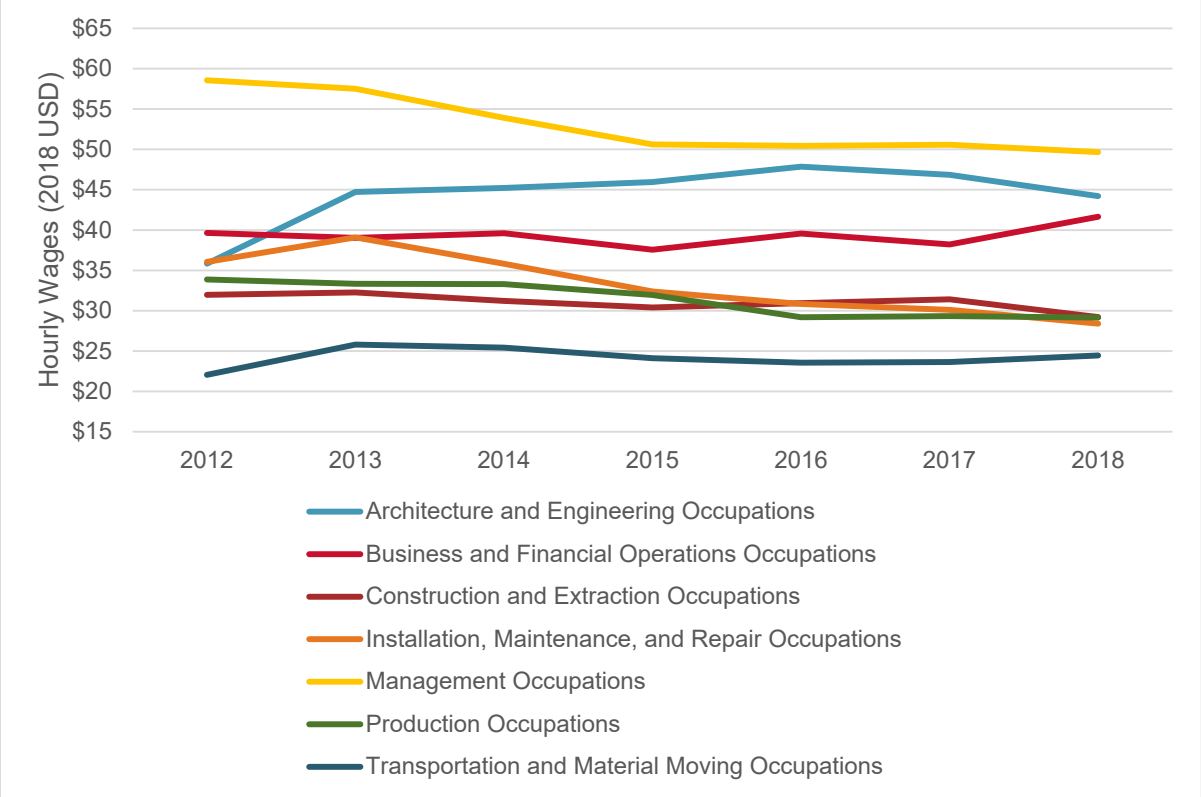


Figure 5-13. US Hourly Wages (median) by Major Construction Occupation Type in the Heavy and Civil Engineering Industry

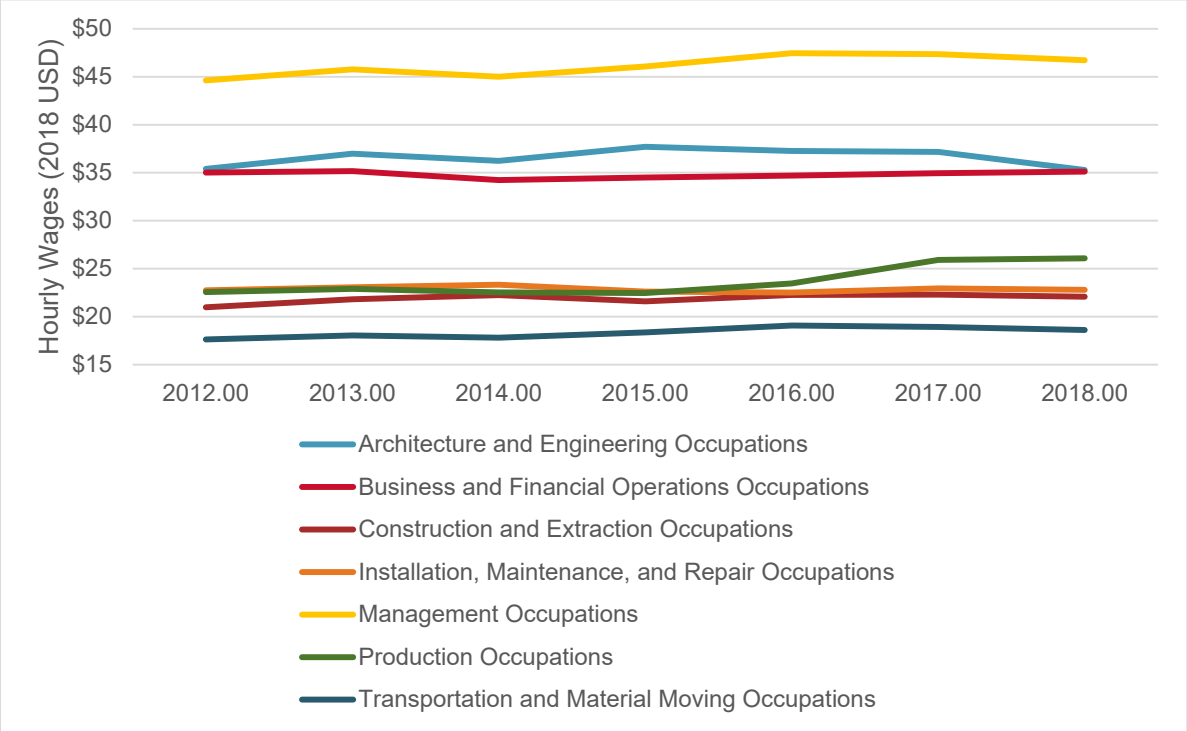


Figure 5-14. Comparison of Hourly Wages (Mean) Across Jurisdictions and Industries

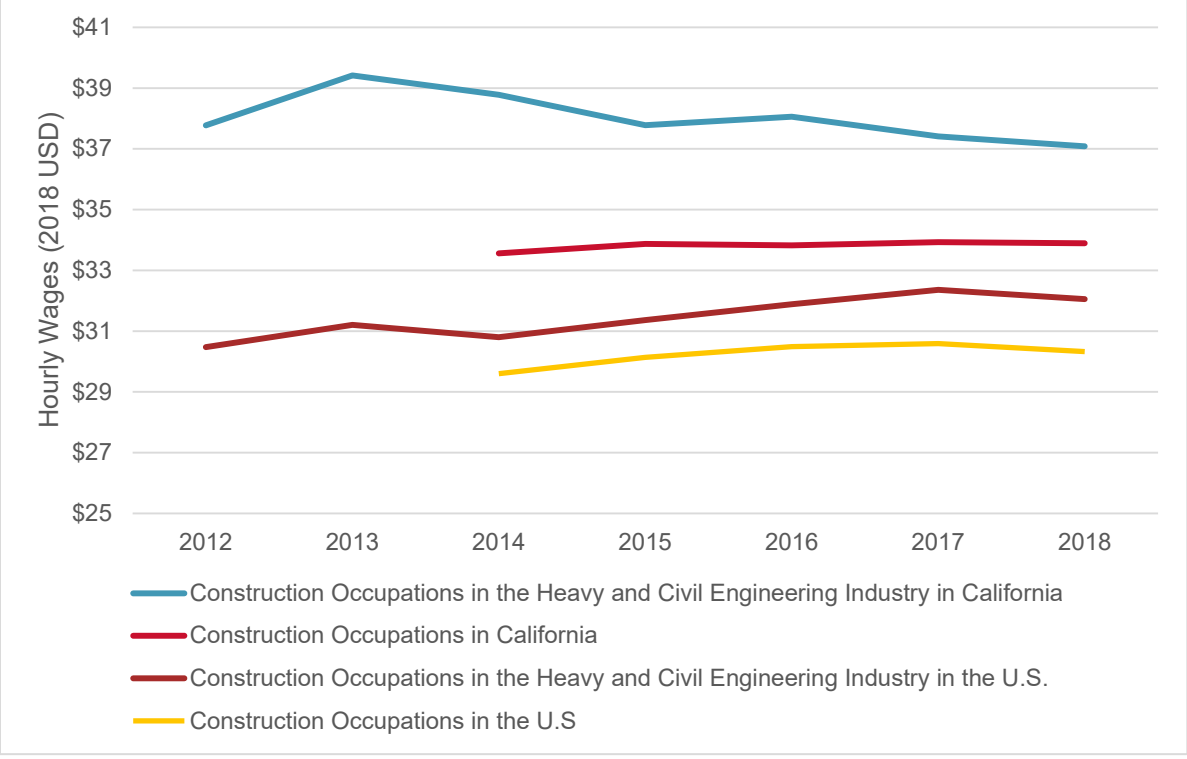
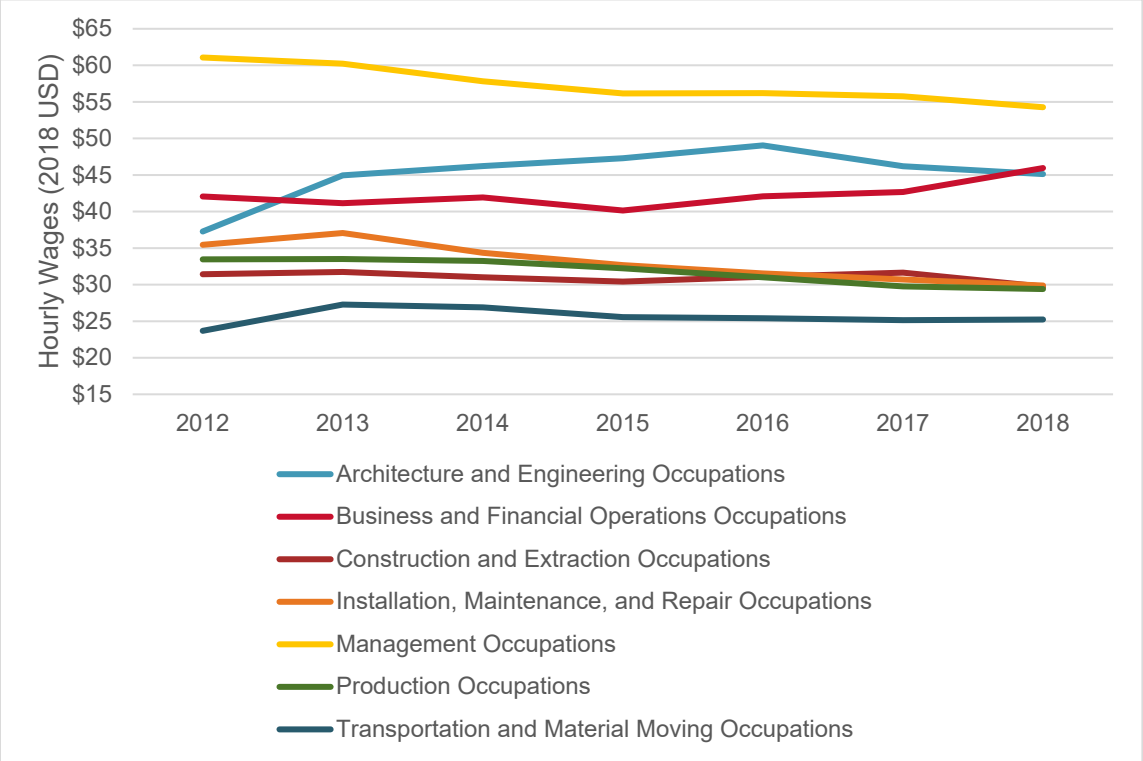


Figure 5-15. California Hourly Wages (Mean) by Major Construction Occupation Type in the Heavy and Civil Engineering Industry



5.4 Results from the Analysis of Department of Industrial Relations Highway Construction Wage Data

HDR also examined wage data from DIR. All workers employed on public works projects in California must be paid the prevailing wage determined by DIR, according to the type of work and location of the project. The prevailing wage rates set by DIR are usually based on rates specific in collective bargaining agreements.[29] The data for this analysis are based of 866 downloaded PDF files from the DIR website and spans the period from 2012 to end of June 2019. [30]

HDR focused on the prevailing wages of 22 trades involved in the construction of highway in four jurisdictions (statewide, northern region, southern region, and San Diego). The intent of this analysis was to identify trends in the prevailing wages of the selected construction occupations in California between 2012 and 2019, and then since 2017. If the wages of occupations closely associated with highway and bridge

[29] The Department of Industrial Relations (DIR) Prevailing wage requirements. Accessed on December 13, 2019 from: https://www.dir.ca.gov/Public-Works/Prevailing-Wage.html

[30] State of California Department of Industrial Relations – Director's General Prevailing Wage Determinations. Downloaded during July 24th 2019 to August 6th 2019 from: https://www.dir.ca.gov/oprl/dprewagedetermination.htm

construction showed increasing trends since 2017 relative to prior trends, the change could signify an impact from the SB 1 funding that was initiated in July 2017.

The DIR data are published on a semi-annual basis. HDR converted the published PDF data into Excel workbook (XLSX) files. The data from the San Diego region was merged with the southern region data. HDR combined total hourly wage data of all trades into one master file organized by jurisdiction, trade, area, shift,[31] group, year, and semi-period. Furthermore, HDR converted total hourly wages to 2018 dollars using the California consumer price index (CPI) of urban wage earners and clerical workers provided in the DIR website.[32]

5.4.1 Regression Models

HDR developed 31 regression models, one for each craft-jurisdiction pair, to explore trends in real total hourly wage over time, controlling for seasonality, area, shift, and group. HDR incorporated a variable to determine if there was a statistically significant impact in wage determination since July 2017. The regression models produced by the team had a good statistical fit with the adjusted R^2 greater than 0.8, which demonstrates the predictability of the employment and wage trends as a function of time.

5.4.2 Total Hourly Wages Analysis

Table 5-1 shows that total hourly wages have generally increased since 2012. Most of the occupations experienced statistically significant increases in total hourly wages from 2012 to 2019. In contrast, real total hourly wages for the majority of occupations focused on highway and bridge construction have been decreasing or have not changed since the implementation of SB 1 in 2017.

Table 5-1. DIR Analysis Results

Trade with Determined Prevailing Wage	Trends (2012 2019)	Trends (2017 2019)
Cement Mason (Southern) Parking and Highway Improvement Painter (Northern) Slurry Seal Worker (Laborer) (Northern)	↔	↔
Dump Truck Driver (On/Off-Hauling) (State Level) Telecommunications Technician (State Level)* Light Fixture Maintenance (Southern)	↓	↓
Gunite Worker (Laborer) (Southern) Iron Worker (State Level) Mixer Driver (On/Off-Hauling) (State Level) Teamster (for work on construction site) – Subjourneyman (Southern) Tunnel Worker (Laborer) (Southern)	↑	↔
Dredger Operating Engineer (Northern)	↑	↑

[31] The Department of Industrial Relations (DIR) defines shift as "the designated hours of work for an employee, with a designated beginning time and quitting time." Accessed on December 12, 2019 from: https://www.dir.ca.gov/dlse/Glossary.asp?Button1=S

[32] State of California Department of Industrial Relations – California Consumer Price Index. Accessed on August 14th, 2019 from: https://www.dir.ca.gov/oprl/CAPriceIndex.htm

Table 5-1. DIR Analysis Results

Trade with Determined Prevailing Wage	Trends (2012 2019)	Trends (2017 2019)
Boilermaker-Blacksmith (State Level)* Cement Mason (Northern) Dredger (Operating Engineer) (Southern) Electrical Utility Lineman (State Level) Operating Engineer (Northern, Southern) Parking and Highway Improvement Laborer (Northern, Southern) Pile Driver (Op. Engineer-Heavy and Highway Work) (Northern, Southern) Steel Erector and Fabricator (Northern) Teamster (for work on construction site) (Northern, Southern) Traffic Control/Lane Closure (Laborer) (Northern) Tunnel (Operating Engineer) (Southern) Tunnel Worker (Laborer) (Northern)	↑	↓

* Occupations used for comparison.

5.5 SB 1's Impact on Availability of Construction Labor Skills and Wages - Synopsis

The construction and extraction occupation is the primary construction labor category, representing on average (median) 61% to 65% of the construction contractors' payrolls. Since 2018, firms have experienced skill shortages, especially in construction and extraction occupations (79% had shortages in trades such as cement masons, concrete finishers, paving personal, journey trades, etc.). AGC (2019) stated that 68% of California construction firms across all industry sectors had difficulty finding craft worker positions. The feedback from this study's construction contractor's survey echoes the findings from the AGC (Simonson, September 17, 2019) and compounds the seriousness of this skills shortage.

Many contractors had commented that the "lack of skilled labor" and "competition for limited number of skilled workers" are drivers of shortages and suggested that there is a shortage of skilled labor. Despite the labor shortages, the majority of construction firms (85%) plan to expand their workforce in the next five years. Moreover, only a small percentage (21%) of the firms who have at least some familiarity with SB 1 attributed some of the skill shortages to SB 1, while most (41%) were uncertain about the effects of SB 1.

Since 2018, most firms (91%) experienced an increased in their overall wages, with a median increase in wages of 4%. In the next year, most firms (82%) expect an increase in their overall wages, again with a median increase of 4%. However, only a small portion (26%) of construction contractors who are at least somewhat familiar with SB 1 attributed some of the wage changes to SB 1. On the contrary, most (36%) of the respondents who were at least familiar with SB 1 did not attribute any of the wage changes to SB 1.

Construction contractors as well as material suppliers and producers who participated in the study noted how shortages of truck drivers in the transportation and material moving occupations has impacted both the availability and scheduling of construction materials (36% said this was a factor) and their escalating prices (43% said this was a factor).

Trucking Impact on Material Prices

Contractors and suppliers noted shortages of truck drivers and trucking services as reasons for material price increases.

During the focus group session, a participant highlighted the potential for more pressure on the trucking industry and drivers from California AB 5, which will go into effect on January 1, 2020. Its regulations may make it extremely difficult for firms and trucking companies from hiring independent truck drivers due to the new classification of independent drivers, driving availability down, while increasing costs. The regulations appointed to the California Air Resources Board (CARB) were cited several times by construction contractors and material suppliers and producers as driving costs up for the trucking industry, resulting in fewer truck drivers.

The information collected from study participants is consistent with the messages found in research studies and news articles on the topic of construction and trucking workforce availability and wages. Issues with finding the right skill sets to match the job opportunities are long standing. Wages have increased steadily in these sectors sector, and recently by 4% per year to accommodate in a seller's market. As of the end of 2018, BLS wage data for the construction and extraction occupations do not yet indicate the sharp rise in wages that could signal the presence and impact of projects funded under SB 1.

HDR further examined the specific highway and bridge construction trades using the DIR data over the period of 2012 to 2019 and then 2017 to 2019, but still did not find evidence of an SB 1 impact. At this point, to attribute impacts from SB 1 on workforce availability and wages is premature. More time and data are required before definitive conclusions can be made.

As demand for skills ramps up with a greater number of auctioned public construction projects, there will continue to be a bottleneck (as there is now) in the numbers of skilled and available construction and trucking workers. At the time of this study, only about a quarter of construction contractors familiar with SB 1 could attribute some impact of SB 1 on current wage increases and skills shortages. If the Department continues to roll-out projects at a faster pace, contractors may have greater difficulties finding and retaining staff, and have to increases wages, even above scale, to fill its needs.

Focus group participants indicated that if the incremental increase in projects doubled or tripled compared to last year's observed incremental increase, contractors would have difficulty meeting capacity. The Department should review how many projects let during FY2018-19 were funded by SB 1 and monitor that the total dollar awards for the additional projects set for FY2019-20 and FY2020-21 (due to SB 1) do not exceed triple the amount observed during FY2018-19.

Chapter 6. Caltrans' Capacity to Plan, Manage, and Attract Bidders for Projects

Caltrans Capacity

Survey participants offered a number of suggestions on how the Department can improve its capacity to plan, manage, and attract bidders for projects.

Survey participants offered a number of suggestions on how the Department can improve its capacity to plan, manage, and attract bidders for projects as additional funding is made available under SB 1. In order for the Department to plan, manage, and attract bidders for projects, Caltrans staffing levels will need to be at a minimum maintained and optimally increased. The Department's auctioning process needs to be simplified, and designed to encourage as many firms as possible to bid. By understanding the competitive landscape in the construction market, Caltrans can package project specifications to attract a mix of firms interested in different sizes or project and delivery methods.

For FY2018-19, Caltrans experienced a $1.9 billion budget increase that allowed the Department to fill an additional 1,237 vacancies. This budget increase will bring Caltrans employees to a maximum of 20,258 positions. Even with the overall increase in the total number of positions, the Department will still have almost 10% fewer positions than it did a decade ago (Caltrans – Mile Marker, Winter 2019). Note that these statistics exclude seasoned employees being replaced by new graduate employees.

Assuming that the Department is able to fill the additional 1,237 vacancies, the Department will still need to add more positions in order to plan, manage, and attract bidders for additional projects under SB 1. This chapter summarizes HDR's investigation of SB 1's impact on government officials in planning, managing, and attracting bidders. The key findings have been gathered across the results from surveying government employees, and interviewing construction contractors, material suppliers and producers, and industry and trade associations.

6.1 Key Findings

6.1.1 Results from Government Staff Survey

Professional Staff

- Most respondents (56%) were involved in highway, road, or bridge construction engineering services, with the remainder in planning and other services.
    - All 12 Caltrans districts were represented by respondents, with Districts 3 and 6 having the largest shares of respondents at 20% each, followed by District 2 at 11%.
- Respondents expected that 16% to 20% (median percentage category) of current engineers would retire over the next five years. Six percent (6%) to 10% of planners and contracting and procurement professionals were expected to retire over the next five years.

  - Fifty percent (50%) of respondents thought that vacant engineering positions would be fully filled, while 32% said that engineering positions would filled at a rate of 50% to 100%.
  - Twenty-four percent (24%) of respondents thought that all other professional vacant positions would be fully filled, and another 24% stated a replacement rate of 50% to under 100%.
- Most respondents (42%) anticipated an increase in future staffing, while 31% were unsure.
- The number of engineering students per office ranged from 0 to 10 students, with an average of 1.4 students per respondent's office. Less than 50% of respondents had any students in their offices.
  - Respondents who did have students in their offices believed that 76% to 80% (median percentage category) of students will become full-time employees over the next five years.
- Respondents said that their succession plan includes good documentation, job rotation, and job shadowing.
- Respondents said that it takes 3 months (median) to fill vacancies for planners and contracting and procurement professionals, though it might take as long as 12 months.
  - It takes longer to fill engineering vacancies. In particular, respondents expected that an engineering vacancy would take an average (median) of 6 months to fill, with a maximum value as high as 4 years (48 months).
- When comparing the rates at which vacancies are currently filled, 44% of the respondents said that it took them just as long or longer to fill the vacancies in FY2016-17 or prior.
  - Only 28% said that they were previously able to fill the vacancies faster.
  - Only a third of respondents foresaw an increase in the current hiring lead time.
- Respondents believed that it takes 2 months (median) for a new recruit or hire with 3 to 5 years of experience to become competent in the new role.

Future Projects Funded Under SB 1

- Respondents expected to work on a large number of projects valued between $500,000 and $10 million.
  - The results indicated an average (median) of 23 projects per respondent's office, valued between $500,000 and $10 million over the next five years.
  - Additionally, an average (median) of 10 projects per respondent's office valued at less than $500,000 were expected to be built.
- Respondents expected to work on a large number of maintenance or repair projects, with an average (median) of 25 projects per respondent's office over the next five years.

- In addition, respondents said that they were planning to work on an average (median) of 10 new construction projects per respondent's office.

- Over the next five years, respondents expected to work on an average (median) of 45 DBB projects, although the numbers might range from 0 to 500 projects.
  - In comparison, over the next five years, respondents expected to work on an average (median) of 9 CMGC projects and an average (median) of 1 design-build project.

Contractors' Concerns

Nearly 53% of respondents had not heard any concerns from their contractors or consultants regarding their capability to manage the increased number of infrastructure projects related to SB 1 funding. Alternatively, 29% said that they have heard concerns from their contractors or consultants.

6.1.2 Results from Focus Group Session

- Complicated specifications, regulations, and other bureaucratic impediments of the Department are affecting the attractiveness of projects funded by SB 1.
- Participants were concerned about the Department's capacity to issue projects.
- Still, the Department's projects are a main draw for bidders as summarized by one participant: *'Caltrans is still one of the most attractive projects. We have learned to deal with Caltrans.'*

6.2 Factors that Impact the Ability of Government Staff to Plan and Manage

The Department's capacity to plan, manage, and attract bidders for projects depends heavily on their ability to recruit and retain a highly skilled and qualified workforce, and flexibility to offer attractive contract conditions and terms that encourage contractors to bid in a competitive environment.

6.2.1 Caltrans' Ability to Have Sufficient Staffing Levels

Many departments of transportation (DOTs) around the country are currently facing complex challenges in recruiting and retaining the staffing levels necessary to function effectively. Some of the factors influencing this shortage stems from an insufficient number of engineering graduates who choose to work at DOTs, and for those that do, enter with transportation knowledge deficits. There are also issues with demographic changes to the workforce, retention, and increasing levels of experienced staff retiring, adding to the expertise and leadership deficit (Selma, Khwaja, Machemehl, Motamed, and Lavaye, 2016).

Caltrans is not an exception. In a memorandum of understanding (MOU) published by the Legislative Analyst's Office (LAO) (August 28, 2018), the Department stated that it has been difficult to fill positions due to a combination of challenges in hiring new people and increases in retirements. In fact, a 2018 media release report available from the

Department stated that for every five new hires, four retire. (Caltrans – Mile Marker, Summer 2018)

As experienced staff continue to retire and taking their knowledge with them, DOTs are losing considerable resources. In addition, new employees do not possess the knowledge and experiences to replicate the work done by current employees. Further complicating the situation is the loss of trained employees. Once new employees gain valuable knowledge and experience, they frequently leave for private firms or other organizations that offer more (higher salaries and better opportunities for promotions) than DOTs can offer. Many DOTs are struggling to retain staff with valuable skills. As the demand for transportation construction projects continues to increase, DOTs must realize that hiring and retaining employees is critical for the long run (Harper, Bogus Halter, Kommalapati, and Choe, 2018).

Demographic changes pose a significant challenge in the government workforce. Mile Marker (Caltrans, Summer 2018) posted that in 2018, about 54% of the Department's workforce is age 50 or older. Of those workers, nearly 67% are managers and supervisors. As the older generation continues to retire, Millennials are rapidly the largest cohort in the transportation industry workforce (Gallagher, Villwock-Witte, 2016).

State DOTs are addressing this shortage in a variety of ways. Through a high school cooperative program, Texas Department of Transportation (TxDOT) encourages students to consider a career in transportation engineering. Other DOTs offer summer internship for college students to familiarize students with state DOT work and provide them with the opportunity to work with transportation professionals (Selma et al., 2016).

Caltrans started hosting career fairs in 2017 to promote recruitment. The Department is also making a strong effort to retain and document the institutional knowledge of its experienced staff before they retire. In order to retain institutional knowledge, the Department updated its knowledge transfer guidebook. The guidebook include an outline ways to help the succession planning. (Caltrans – Mile Marker, Summer 2018).

After six years of consecutive reductions in total employees at the Department since FY2011–12, employee hiring has been on a rebound since FY2018–19. For example, the change in budgeted employees who are part of the Capital Outlay Support (COS) program between FY2017–18 and FY2018–19 was set at 9% (Legislative Analyst's Office, May 13, 2018). Based on the FY2018–19 budget, the Department can fill an additional 1,237 vacancies, up to a maximum of 20,258 positions, total numbers not seen since the first decade of this century, when year-over-year transportation revenues from fuel taxes grow on average 9% per year between FY2000–01 to FY2007–08.

6.2.2 Caltrans' Ability to Attract Bidders

It is crucial for the Department to receive value for its money – this includes obtaining a sufficient number of competitive bids from contractors. A study, designed to improve the estimation probability of bidder participation in procurement auctions, found that when there is a transparent process and bidders have an idea in advance of their likely competitors, they are more likely to participate in the procurement process (Ballesteros-Peréz, Skitmore, Pellicer, and Guitiérrez-Bahamondes, 2016).

Drew and Skitmore (1997) found that competitive variability depends on cost estimates, markup policies, costing error, and regional market conditions. High competitive variability could be an indicator that the specifications provided in the procurement process are not clear. Participants from the focus group stated that complicated specifications, regulations, and other bureaucratic impediments of the Department are affecting the attractiveness of projects.

A study by Bezer (2010) found that invitations to bid (ITBs) and requests for proposal (RFPs) that allow for more competitive bidding lower the costs of projects accomplished through contracting. ITBs are designed to attract suppliers at the least expensive price, while RFPs place greater emphasis on the quality of the product. Caltrans has a long-standing and effective RFP procurement process for bidders to pre-qualify and submit bids. The Department offers a wide array of instructional guides to help contractors comply with submission requirements. The process is transparent, but the Department can do more to attract bidders in an era of changing workforce dynamics, industry consolidation, availability of construction materials, and increased demand from SB 1 funding.

6.3 SB 1's Effects on Caltrans' Capacity to Plan, Manage, and Attract Bidders - Synopsis

Caltrans Staffing

Staffing level at the Department will need to be maintained at a minimum, and optimally increased.

As SB 1 funding ramps up over current and future fiscal years, staffing levels will need to be at a minimum maintained, and optimally increased, so that the Department can efficiently plan and manage the incremental projects funded by SB 1. The responses from the government officials who participated in the survey corroborate staffing budget trends available from the Department (Caltrans – Mile Marker, winter 2019).

Between FY2011-12 to FY2016-17, the Department's staffing numbers steadily decreased such that staff numbers dropped by 6.8%, with numbers in May 2017 being the lowest in a decade. However, since May 2017, the Department has been steadily hiring. A MOU published by the LAO (August 28, 2018) estimated that, between May 2017 and March 2018, the Department hired on average 53 employees and lost 41 each month, for a net increase of 12 each month. Caltrans survey respondents said that they expect about 16% to 20% of their engineering staff to retire over the next five years (about 3.6% per year). This is a high retirement rate compared to what the BLS reports for the national annual average "other separation" rate for professional services (only 0.3% per year).[33] In fact, a 2018 report available from the Department stated that, for every five new hires by the Department, four employees retire (Caltrans – Mile Marker, Summer 2018).

Given this retirement surge, government staff participants said (at a rate of 42%) that their offices planned to increase staffing levels and that vacant engineering positions would be replaced at rates of at least 50% (32% of respondents) to a maximum of 100%

[33] https://www.bls.gov/news.release/pdf/jolts.pdf, accessed November 20, 2019.

(50% of respondents). The comments provided by the government staff regarding succession plans indicated that the Department has been proactive in transferring in-house knowledge and can quickly bring new recruits up to speed for optimal job performance.

However, with lead times to hire key skills in engineering services ranging from six months to up to two years, the Department will need to keep up the pace with its planned job fairs and advertisements, and might also need to use recruiting agencies. One mitigating factor is the high rate of retaining student engineers. Respondents who have interns in their offices estimated that 76% to 80% of these student engineers would be hired within the next five years.

Government staff estimated by project size and category the number of projects to be funded by SB 1 over the next five years. Maintenance and rehabilitation projects were estimated at an average (median) value of 25 such projects per respondent's office with typical values ranging from $500,000 to $10 million per project. Other project categories for new construction and expansion had lower expected numbers per respondent's office (10 and 5 projects, respectively). These responses are in line with the allocation of SB 1 funds, in which the majority (approximately 66%) of annual SB 1 funds are directed toward the road maintenance and rehabilitation account, including maintenance and SHOPP projects under the State Highway Account.

Respondents overwhelmingly chose DBB as the delivery method for the future projects delivered under SB 1, with an average (median) of 45 such projects over the next five years per respondent's office, followed by CMGC at an average (median) of 9 projects and design-bid at an average (median) of only 1 project. Although DBB is currently the most common delivery method for Caltrans highway or bridge construction projects, the Department's ability to hire multiple contractors as prescribed by this method under one main contract could be curtailed if contractor capacity is reduced in a construction market of increased demand.

Participants from the focus group provided valuable insight into ways the Department can package and specify projects to make them more attractive to bidders, over and above the project delivery method. While the group recognized the Department projects as highly attractive and have learned to navigate the bureaucracy, they noted some obstacles if there is a significant increase in let projects.

Quote from Focus Group

"A valid question for this analysis would be whether the Department can convert SB 1 funds into projects."

For example, the group noted that the Department's projects have a bigger risk due their complicated specifications, regulations, inflexible schedules, and other bureaucratic impediments. A number of participants said that private projects involve less risk, and that the market will move to the path of less resistance, that is, "*Contractors will go to the path of less resistance and more profit. If a private project offers bigger profits, contractors will move to those projects.*"

Focus group participants were frank in their observations that they questioned whether the Department had the capacity to issue a higher level of projects then in recent years. One participated stated "*The potential growth with SB 1 money is yet to be seen.*

Caltrans is struggling to hire and to put projects out. These factors could create a potential bottleneck."

The group wondered how the Department would allocate the SB 1 funds. Would the Department increase the number of projects with smaller dollar amounts or issue fewer projects with some designed as megaprojects? If the former, then a more diverse pool of bidders could bid on the projects (though the set of smaller projects would bring in some inefficiencies from higher project management overhead), if the latter, the pool of bidders could be constricted. The Department needs to optimize the balance between smaller and larger to ensure a sufficient number of bidding contractors. As described earlier, the Department can monitor the number of bidders by size of project and bid variability over time as more projects are let. The Department can also solicit input from eligible contractors as to why they bid or declined to bid on projects. This will allow the Department to determine the appropriate mix of small and large projects.

The Department's staff works closely with its contractors and hear daily about the issues that contractors face. The majority (53%) of respondents had not heard any concerns from contractors related to the increased demand from SB 1 funds, while 29% of respondents said that contractors had expressed concerns. This disparity reflects the fact that the full potential of SB 1 funding has not "hit the streets," and the pressures experienced by contractors are not homogenous across all types of contractors and geographies in California.

One responding government employee said, "There are actually not enough paving jobs out there right now for the construction industry to bid and they are wondering where all the SB 1 $ are." Another respondent offered an opposite observation, saying, "In conversations with contractors, they have said that SB 1 has completely flooded the market with work and there are inadequate labor, materials, and equipment resources available, leading to greatly increased construction costs."

Quote from Government Survey

"There are actually not enough paving jobs out there right now for the construction industry to bid and they are wondering where all the SB 1 $ are."

Finally, some of the government staff who participated in the survey shared common optimism that SB 1 funding will bring benefits to California's transportation system. However, respondents were aware that construction costs will increase due to the increased demand (some are already observing this) and that greater efficiencies can be attained through better management by the Department.

Chapter 7. Updates to California Highway Construction Cost Index

Cost escalation is critical when planning and budgeting for construction projects, particularly as part of a large expenditure program such as the additional funding made available under SB 1. Construction cost forecasting includes escalation factors as forward-looking adjustments for potential events that can affect construction costs. The use of cost escalation allows the Department to develop accurate bid estimates and anticipate how far the revenues generated by transportation funding sources can go in programming projects.

Cost escalation factors are meant to account for future changes in market behavior, policies, and economic conditions. For instance, cost escalation factors should increase if the Department anticipates future events, such as a shortage of construction materials or a substantial increase in the number of projects, will drive up construction costs. The surveys and focus group participants pointed to two such factors related to SB 1 funding: 1) increases in labor wages due to shortages in skilled labor, and 2) potential short-term disruptions due to industrial capacity not meeting construction demand.

In a prior work, HDR examined different methods to estimate cost escalation factors and developed a methodology to forecast the California Highway Construction Cost Index (CHCCI). The CHCCI is a composite cost index that captures changes in the historical costs of several key construction items:

- Roadway excavation
- Aggregate base
- Asphalt concrete pavement
- Portland cement concrete (for pavement)
- Portland cement concrete (for structures)
- Bar reinforcing steel.

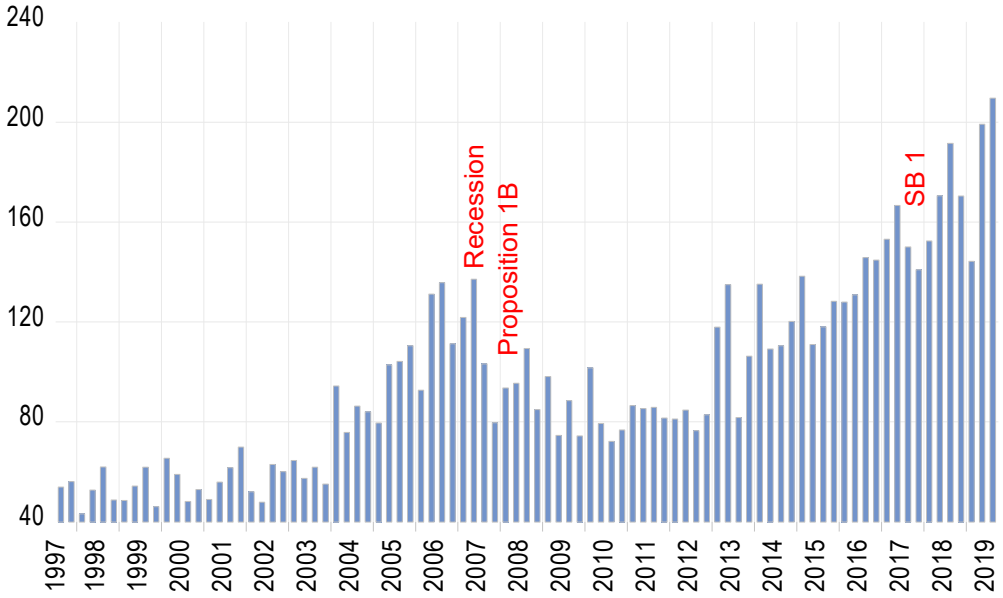
The HDR forecast methodology uses econometric (statistical) analysis to account for seasonality and market factors that affect construction prices. The methodology addresses a number factors, such as diesel fuel prices, mortgage rates, and the average number of bidders. However, it does not consider the potential market shock that SB 1 could have on construction costs. Using input provided by the surveys and the focus group, HDR updated the prior CHCCI forecasts to take into account increases in labor wages and potential short-term disruptions in industrial capacity. The updates also take into account more recent economic data up to the third quarter of 2019 that show economic growth has continued longer than previously anticipated. Statistical details from the updated CHCCI methodology are provided in Appendix G.

7.1 Historical Trends in Construction Cost Index

Figure 7-1 shows the CHCCI through the third quarter of 2019, with 2007 as the base period. The index grew rapidly during the housing boom through the third quarter of

2006. In 2006, highway construction costs increased by 18.6 percent, well above general inflation in California (3.9 percent). The index reached a peak in the second quarter of 2007 before declining by 30 percent by the end of 2010, as a result of the slump in the housing market and the ensuing economic recession. The index stagnated in 2011 and 2012. Since 2013, the index has been on a strong and steady upward trend. In the third quarter of 2019 it stood 161 percent higher than in 2012.

Figure 7-1. California Highway Construction Cost Index (2000 Q1 – 2019 Q3)



Source: Caltrans, Division of Engineering Services

Note: Base period: 2007 = 100

Figure 7-1 labels two other events that have the potential to impact California highway construction costs. The first is Proposition 1B (the Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act of 2006), which was approved by California voters in November 2006. Proposition 1B authorized the State of California to sell up to $20 billion in general obligation bonds to fund transportation projects. About $12 billion of this funding was programmed and allocated by the California Transportation Commission through ten different funding programs. Construction expenditures occurred over a ten-year period.

As can be seen in Figure 7-1, the CHCCI declined or remained steady during much of this period despite the influx of new funding. In general, changes in the general economy drove the declines in the CHCCI. The market was able to absorb the additional funding because the economy was declining. Also, the additional funding from Proposition 1B ($1.2 billion annually) was much smaller than that anticipated from SB 1 ($5.3 billion annually).

Comparison to Proposition 1B

Proposition 1B did not reverse the downward pressure of a declining economy on costs, but Proposition 1B funding was much smaller than SB 1.

The second event labeled in the figure is SB 1. As can be seen in Figure 1, the CHCCI has increased since SB 1 has taken effect, but these increases are in line with previous trends. Similar increases have continued into 2019, which suggests that the market has

been able to adjust to the current influx of SB 1 funding. However, as described earlier, only a portion of SB 1 funding has been programmed and let for construction to date. SB 1 could have a larger impact on the CHCCI in future years.

7.2 Econometric Model

To forecast future changes in the CHCCI, HDR developed a methodology that relies on economic theory and the application of statistical methods to time series data. Econometric analysis involves a statistical examination of the potential factors driving highway construction costs. Prior to conducting the econometric analysis, HDR built a conceptual model or framework to illustrate how different factors influence the CHCCI. The factors can be divided into two main categories:

- *Internal factors,* over which Caltrans and its partners exercise some control (such as the delivery method and scope creep)
- *External factors,* which are largely beyond the control of the Department and its partners (such as local market conditions and unforeseen events, especially those of large magnitude called “black swans”).

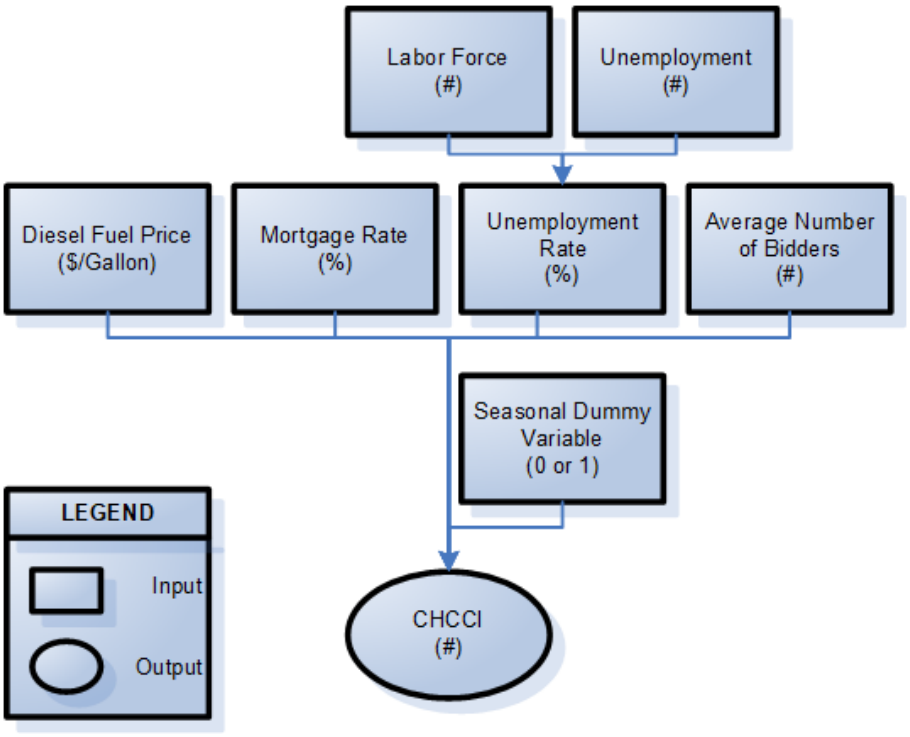
Table 7-1 provides a list of key factors tested in the econometric model development and their expected relationship with the CHCCI. Historical data on these variables can be obtained from various sources at the state and national levels.

Table 7-1. Key Factors and Data Sources for Econometric Model

Variable	Geography	Data Source	Expected Relationship
Mortgage rate (30-year fixed)	U.S.	Freddie Mac	Negative
Employment, unemployment, and unemployment rate	State	Bureau of Labor Statistics	Positive with employment; negative with unemployment
Retail gasoline and diesel fuel prices	State	Energy Information Administration	Positive
Average number of bidders	State	Caltrans	Negative
Crude oil price (Cushing, OK West Texas Intermediate)	U.S.	Energy Information Administration	Positive
Consumer price index (all urban consumers)	State	California Department of Finance	Positive
Wages in construction sector	State	Bureau of Labor Statistics	Positive
Housing starts	State	U.S. Census Bureau	Positive
Highway expenditures	State	FHWA	Positive
Total value of highway projects	State	Caltrans	Positive
Seasonality	State	-	Positive or negative

Based on the key factors and data sources shown in Table 7-1, HDR developed an econometric equation to estimate the CHCCI using a double-log functional form. Both the CHCCI and the predictive factors were transformed using logarithms, which is a method typically used when economic factors involve percent changes. Figure 7-2 presents a conceptual flowchart illustrating the econometric model conducted for the CHCCI.

Figure 7-2. Conceptual Model for CHCCI Forecast



7.3 Potential Impacts of SB 1 on Highway and Bridge Construction Costs Trends

In the earlier work, the CHCCI was projected under different forecast scenarios to help the Department estimate likely construction cost inflation over the next ten years. SB 1 represents a major structural shift in the highway construction market, which makes forecasting construction costs challenging until the CHCCI has enough history to show the likely effects.

HDR updated the CHCCI forecasts using information from the surveys and focus group described in previous chapters as well as more up-to-date data. The original forecasts anticipated a near-term downturn in the economy. More recent economic data show that economic growth has lasted longer than previously expected. A downturn is still expected, but it has been delayed. This growth and expected downturn is included in the updated forecasts.

Accounting for SB 1

CHCCI forecasts were modified to account for escalation in labor costs and potential issues in industrial capacity due to SB 1.

The updated forecasts also include modifications that take into account potential effects from SB 1 construction expenditures. The first modification is wage rate and material cost growth of 2.1% (based on survey and focus group data) to account for escalation in labor costs due to skilled labor shortages.[34] This modification was included in all forecasts. The second modification is a change in the average number of bidders. This modification was added to two forecasts to test the effect of industry capacity not growing with demand. The effect is anticipated to be short-term as the industry adjusts to new construction demand.

HDR prepare four forecasts with definitions similar to the prior work:

- **Scenario 1 (S1), Bidders Revert to Long-Term Average:** average number of bidders is not affected by SB 1 (i.e., equal to the long-term average of 2013Q1 to 2019Q3)
- **Scenario 2 (S2), Bidders Revert to Short-Term Average:** average number of bidders is not affected by SB 1 (i.e., equal to the short-term average of 2018Q1 to 2019Q3)
- **Scenario 3 (S3), Bidders Continue Decline:** average number of bidders declines by 20 percent through 2020 and remains low because of SB 1
- **Scenario 4 (S4), Bidders Decline and Revert to Long-Term Average:** average number of bidders declines by 20 percent through 2020 because of SB 1 and then reverts to the historical long-term average as the market adjusts.

Scenario 1 is a business as usual scenario. It takes into account the new economic data and the impact of escalating labor costs. HDR believes Scenario 1 is the best forecast if the construction industry is able to adjust capacity with market demand. Scenario 2 is a similar forecast, but it expects the average number of bidders on Caltrans projects to revert to a lower short-term average reflective of the recent SB 1 era.

Scenarios 3 and 4 illustrate the effects of the construction industry being unable to scale its capacity to the increased demand with SB 1 funding. In Scenario 3, the number of bidders on Caltrans projects declines and remains low. This scenario is unrealistic, because as participants in the focus group indicated, industry is able to shift resources to meet demand. Scenario 4 models a short-term decline in the average number of bidders as industry responds to increased demand.

Table 7-2 summarizes the annual projections for the socioeconomic explanatory variables used to develop forecasts for each of these scenarios.

Table 7-3 below shows annual CHCCI projections through 2028 under each scenario. Overall, the index is projected to increase through 2020 or 2021 before declining or slowing down in response to a less favorable economic environment. The effect of industrial capacity not being able to meet demand due to SB 1 in the short term is captured by comparing Scenarios 1 and 4. This can be seen in Figure 7-3.

[34] Survey and focus group participants reported increases of 4% for wages and 5% for material costs. The 2.1% includes both increases discounted by the percent of respondents who thought SB 1 had no impact on wages or material costs.

Table 7-2. Forecast Assumptions by Scenario (2019 – 2028)

Variable		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Diesel fuel price (% change)		1.35	10.69	4.14	2.92	4.83	5.47	3.78	2.99	4.58	3.30
Mortgage rate (%)	S1 to S4	3.95	4.30	4.71	5.26	5.39	5.43	5.54	5.71	5.76	5.73
Unemployment rate (%)	S1 to S4	4.12	4.30	4.70	4.80	5.00	5.20	5.20	5.20	5.20	5.20
Average number of bidders	S1 *LT Avg.*	5.3	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
	S2 *ST Avg.*	5.2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	S3 *Decline*	5.2	4.1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
	S4 *Decline to LT Avg.*	5.2	4.1	3.8	3.8	4.4	5.4	5.4	5.4	5.4	5.4

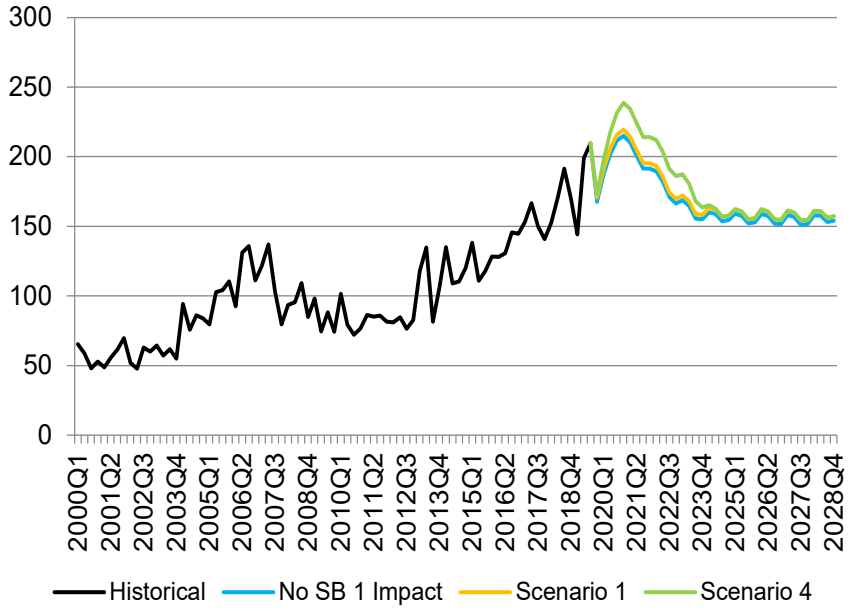
Sources: Energy Information Administration, Annual Energy Outlook (2019); Caltrans, 2019 County-Level Economic Forecast (2019); Moody's Analytics (November 2019).

Table 7-3. Annual CHCCI Projections by Scenario (2019 – 2028)

Scenario		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
S1	Index	188.5	208.3	202.4	180.7	164.3	159.9	158.4	158.1	157.5	158.8
	% change	-	*10.5%*	*-2.8%*	*-10.7%*	*-9.1%*	*-2.7%*	*-0.9%*	*-0.2%*	*-0.4%*	*0.8%*
S2	Index	189.6	212.3	206.5	184.4	167.6	163.1	161.6	161.3	160.7	162.0
	% change	-	*12.0%*	*-2.8%*	*-10.7%*	*-9.1%*	*-2.7%*	*-0.9%*	*-0.2%*	*-0.4%*	*0.8%*
S3	Index	189.7	221.8	221.7	198.2	180.2	175.4	173.8	173.4	172.8	174.2
	% change	-	*16.9%*	*-0.0%*	*-10.6%*	*-9.1%*	*-2.7%*	*-0.9%*	*-0.2%*	*-0.4%*	*0.8%*
S4	Index	189.7	221.8	221.7	198.2	174.9	160.6	158.4	158.1	157.5	158.8
	% change	-	*16.9%*	*-0.0%*	*-10.6%*	*-11.8%*	*-8.1%*	*-1.4%*	*-0.2%*	*-0.4%*	*0.8%*

Note: 2019 projections include actual estimates through 2019 Q3.

Figure 7-3. Impact of Insufficient Industrial Capacity



Effect of SB1 on Costs

SB 1 may affect costs in the near term, but overall market forces still drive construction costs.

The survey and focus group results suggest that industry will be able to increase capacity as the letting of construction accelerates with SB 1. Under this scenario (Scenario 1), SB 1 will have no further effects on the construction cost index. If industry is unable to increase capacity commensurate with the increase in funding, then the average number of bidders per project will drop (Scenario 4). In either case, the construction cost index is expected to grow through 2020 or 2021 and then decline due to a less robust economy. These forecasts show that SB 1 may affect costs in the near term, but overall market forces still drive construction costs.

Chapter 8. Implications for the Department

8.1 Potential Impacts of SB 1 on Highway and Bridge Construction Costs Trends

HDR's research has showed that as of November 2019, the impact of SB 1 funding has been modest. About four in ten of the study's participating firms thought SB 1 had an effect on changes in materials availability and prices, and labor availability and wages, but only 'some' effect. The study's participants felt SB 1 had an even lower effect on changes to labor availability and wages, with only two in ten participants stating that SB 1 had 'some' bearing on the changes.

Nonetheless, the feedback collected from construction contractors, material suppliers and producers, and industry and trade associations centered on the ongoing trends in material shortages (such as asphalt, fly ash, concrete, etc.), delays in order fulfillment, increasing prices for materials and products, difficulties in finding the right labor to complete a job, and labor wage increases, even above union scale. Adding more highway and bridge project auctions to recent demand levels will increase the economic pressures felt by construction industry stakeholders.

With the information available at the time of the study, it was not possible to quantify what those pressures in terms of annual percent cost increases over the next ten years in essential construction materials (aggregate, asphalt, concrete, etc.), construction labor wages, the number of additional staff that the Department needs to hire, or how many more weeks a project's schedule has to be extended.

The Caltrans study team was able to confirm during our monthly call on September 5, 2019 that the full potential of SB 1 funding as of September 2019 has not been achieved. Since the rollout of projects from July 2017 to July 2019 was a transitional phase in SB 1 delivery, the additional funding had a minimal to moderate impact on the construction industry based on feedback provided by the study's participants. Furthermore, participants indicated that the incremental funding would need to be two to three times as much as experienced so far before adverse effects would occur in the market. HDR believes that the Department would have to release the entire planned annual average SB 1 funding as an immediate shock within a single fiscal year for notable incremental changes in construction cost escalation and project delays to be observed. If the construction ramp up continues as in the first two years of SB 1, the impacts will be minimal.

HDR revisited a methodology it had previously developed to forecast construction cost changes. While the model addresses a number of factors, such as diesel fuel prices, mortgage rates, and the average number of bidders, it was unable to consider the potential shock that SB 1 funding may have on construction costs. In updating the forecasts, HDR leveraged increased in labor wages shared by the study's participants. This knowledge coupled with the most recent, available economic indicators was used as input to update CHCCI trends through 2028.

Recent economic data shows that economic growth will continue longer than previously anticipated, so CHCCI growth is expected to continue as well. SB 1 funding is likely to

affect the CHCCI through an escalation in labor costs and changes in industrial capacity. The higher labor costs will increase the CHCCI slightly throughout the forecast period above what would be expected without SB 1 funding.

The effect of industry capacity depends on how quickly additional construction projects are let and how quickly industry is able to react. It will also depend on how the Department manages SB 1 implementation and communicates opportunities to industry. If SB 1 construction proceeds rapidly and industry capacity does not react, the average number of bidders per project will decrease in the short term. Longer term, industry will adjust to the larger demand. Regardless of the immediate effect on industry capacity, construction costs are expected to increase through 2020 or 2021, but then decline due to a contracting economy.

HDR's research into areas of contractor capacity, materials availability and pricing, labor workforce availability and wages, and changes to CHCCI forecasts uncovered some potential effects from SB 1 funding. However, the study's construction contractors, and material suppliers and producers that are closely involved in building, repairing and maintaining California's transportation system see the increase in construction demand as an *opportunity*. These opinions were validated by members of the focus group study, including representative of key industry associations.

The next sections contain HDR's suggestions for implementation based on the study's key findings and ideas for possible next steps in tracking changes to construction cost escalation and the CHCCI.

8.2 Suggestions for Implementation

The comments HDR collected from the various stakeholder surveys are an invaluable source of ideas for ways to improve the implementation of SB 1 funding. The comments together with the corroborating statistics on wage increases, incidences of occupations in short supply, reasons for labor shortages, wage increases or material price increases, etc., provide good and practical advice on ways that Caltrans can work better with the industry and potentially soften the effect of SB 1 funding on the construction market. HDR's top four implementable actions Caltrans can direct are as follows:

1. **Deliver projects slowly to let the market adjust**

    a. The delays in SB 1 project delivery have been beneficial to the industry.

    "Since SB 1 was enacted, I expected a drastic increase in the amount of projects advertised for bid compared to the pace of prior years, however, the amount of projects advertised has been at a steady to somewhat slower pace than anticipated."

    "2018–2019 were transitional years. We expected 2020 and beyond to be fully funded and amount and size of projects to increase."

    "The slow start of SB 1 funds hitting the contractor level will drive capacity issues with trucking, labor, and materials in the future when funds hit the market all at once. A steady stream of projects and $ will allow contractors and material suppliers to better plan for the increased activity and the state to get a lower price and more stable bidding environment."

Caltrans can monitor how its project delivery process impacts the construction market by analyzing its historical bid tabs data. For example, if projects are let too quickly, then the number of bidders on each project may drop over time or the average bid estimates may begin to increase for comparable projects.

2. **Be realistic on what Caltrans communicates to better manage expectations**

   a. Industry has complained about ramping up capacity to meeting expected demand and being disappointed when extra construction spending did not materialize.

      "It does not appear Caltrans is allocating SB 1 funds to rural areas, such as D5, as much as they advertised prior to the SB 1 vote."

      "We are not seeing an increase in projects in our area (Lassen, Modoc, and Plumas Counties). In fact current look ahead appears to be fairly bleak."

   b. Contractors suggest that they have capacity or can make capacity available by shifting resources. Firms develop marketing plans six months to five years ahead and need good planning information from Caltrans.

      "If we could have a better way of forecasting the SB 1 projects that will be bidding in the future 12 months ahead would be very helpful."

      "A steady stream of projects and $ will allow contractors and material suppliers to better plan for the increased activity and the state to get a lower price and more stable bidding environment. Pick up the pace CT!"

3. **Review bidding and construction regulations to make it easier for firms to submit bids and complete work for Caltrans**

   a. Flexible start and end dates for projects

      "We have nothing to gain if a job takes longer. The motivation is to get it done as soon as possible. However, Caltrans' schedule doesn't allow for flexibility, which means that contractors have to pass on projects."

   b. Types of construction materials, tools or methods

      "*Superpave asphalt and its enforcement to a one size fits all standard statewide will limit commercially available materials. If municipality work increases, more suppliers will focus on those projects rather than working for Caltrans, unless Caltrans begins to partner more effectively with industry."*

      "Air regulations for trucks and construction equipment requires buying new equipment."

      "Larger scale projects which require more technical mix designs, more time and effort invested to meet tight specifications."

      "Steel costs are up and only 2 pole vendors [are] approved to make California (CA) poles."

"New regulations are making the production of asphalt more difficult."

c. Timely payment

"Caltrans is one of the only agencies where there are issues with paying a simple bill. It can get frustrating and if there are opportunities to go elsewhere they will do that. That is working against the Department."

Caltrans strives to pay all invoices in a timely manner. A June 2015 Mile Marker document indicated that Caltrans pays more than 99.99 percent of its invoices on time.[35] While the records show payments are made on time, some of contractors or suppliers may not have this perception.

4. Improve cost estimation to optimize the use of available funds, remain competitive, and attract multiple bidders

a. Factor in trucking costs for sites that are far from aggregates or plants.

"CARB regulations are driving truckers out of the industry. That coupled with fire cleanup has made for huge shortages in trucking which has driven the price of trucking up nearly 25% in the last 2 years."

Depending the location of a project and the permitted material, the "cost of transportation quickly exceed the value of the material." (Ghilotti, 2018)

b. Incorporate expected increases in wage, material, and transportation costs.

"The cost of everything is going up. Please tell agencies to adjust accordingly, and to take into account that they haven't been adjusting their estimates for too long. I'd like to make a living wage, which non-union employees (our entire office) deserve, too."

"We're just paying more due to demand and tariffs. That means everyone's estimates will be higher in the future. Half of our bids this summer were sent to rebid because no one bid at or below the engineer's estimate and I don't see agencies taking these changes into account yet."

"The immediate increase in workload and projects is anticipated to plateau or reduce as funding sources are impacted by shrinking revenues."

Use of the updated CHCCI will allow Caltrans cost estimators to forecast project costs up to the fourth quarter 2028 based on current trends in wages, materials and transportation costs. The percent changes in the CHCCI between two periods of interest can be used to escalate current project costs from the first period to the last period.

[35] Caltrans Late Payment Penalties Continue to Drop, https://dot.ca.gov/-/media/dot-media/programs/risk-strategic-management/documents/mm-2015-q2-financial-late-payment-a11y.pdf, accessed February 13, 2020.

8.3 Prospective Next Steps

Caltrans and the State of California are committed to improving California's transportation system. The key ingredients are a trained and available workforce, materials availability, trucking availability, and clear communications strategies. HDR's review of information on government websites, trade newsletters and interviews with Caltrans and local agency staff show that a significant amount of funding is made available to grow, retain and train government staff and to encourage the younger generations to seriously consider the construction trades as a viable career.

Communicating SB 1 information and progress to stakeholders, both within the government and in the construction industry requires an investment in information technology and communication protocols. A study by Butler and Harrington, 2018 revealed that there were major impediments to hiring data analysts and software engineers at Caltrans. Without such skills, the Department may find it difficult to monitor performance of SB 1 programming goals on a quarterly basis, and in time to anticipate issues with contractor capacity, materials availability, materials price increases and labor shortages.

8.3.1 Stakeholder Perspectives

Construction contractors and material suppliers and producers and their association representatives genuinely want to partner with the Department to keep California's transportation infrastructure working as evidenced from the ample number of positive and optimistic statements from study participants. The following comments (quoted verbatim) are examples of the good feedback collected from the industry:

Construction Contractors

"SB 1 funding is critical to keeping California's economy moving. The lack of funding has taken a toll on our infrastructure and economy. With the lack of funding from before, Contractors have been taking care of more of their own work. SB 1 will also allow us all to get back to business."

"The work was not available before SB 1 was in place. Skilled workers retired or moved on to other professions. But with SB 1, people are returning to the industry."

"Please keep SB 1 in effect, we get a significant amount of work from Caltrans other public works projects. Also our roadways and infrastructure greatly need it."

"I think it's great to finally see some funding"

Materials Suppliers and Producers

"Good infrastructure is required for a successful economy. SB 1 keeps California moving and improves the quality of life for all."

"I believe ultimately it will spur demand."

"It's going to be a great thing creating jobs and increasing sales to meet the demands of the needs from the contractors."

Industry and Trade Associations

"The extra funding will create numerous jobs by reducing a backlog of infrastructure projects."

"Sb1 funding will provide local jobs with secure $$"

Focus Group

"I heard everyone saying they are not back to pre-recession capacities and are more than ready for a large increase in projects coming to the market."

"We can do a lot more than what is currently out in the market."

As far as capacity is concerned, there is plenty. We have the capacity and need more projects."

"Caltrans is still one of the most attractive projects."

8.3.2 What Can Caltrans Do?

Caltrans needs to continue to leverage these existing partnerships and foster more opportunities to collaborate and streamline working relationships, while still respecting labor and environmental regulations.

With Caltrans committed to rolling out projects in a timely and cost effective manner, HDR has the following suggestions as prospective next steps:

1. Keep up internal hiring goals and training to have adequate and trained staff who can meet SB 1 demand
2. Partner with industry to keep pace with construction best practices such as materials composition, equipment improvements, paving processes, environmental impacts, sustainability, and staff recruiting and training
3. Use the updated CHCCI to forecast highway construction costs up to the fourth quarter of 2028
4. Refresh the CHCCI forecast on an annual basis to incorporate the latest trends in materials, wages and transportation costs
    a. Refresh the CHCCI model once a year. Any statistical software application (e.g., Eviews, SPSS, SAS, Stata, etc.) that can fit a least squares regression model can be used to update the model. Excel can also be used to refresh the model's coefficients for a few years before a major refresh.
    b. Consider creating separate forecasts for major item classifications such as roadway excavation, concrete pavement, bituminous pavement, reinforcing steel, structural steel, and structural concrete. Having separate indexes will improve the accuracy of project cost estimates
    c. Potentially conduct follow-on surveys or focus groups to monitor the impact of SB 1 funding on industry composition
5. Monitor changes in industry consolidation and firm composition to anticipate contractor capacity to bid

   a. Potentially conduct follow-on surveys or focus groups to monitor the impact of SB 1 funding on industry composition

6. Build and maintain a documented, accessible, electronic database of bid data to monitor the construction and materials market through changes in pricing and number of bidders per bid

   a. Applying statistical techniques to changes in item prices, number of bidders, or bid variability per project will allow Caltrans to correlate changes in bidding behavior to firm capacity (are more firms bidding or fewer?) or shortages of labor or materials. The progression of project awards over time can be studied by factors such as the number of bidders, project work type, project size, or project location. By understanding how changes in bidders, project work types or other project characteristics impact project cost estimates and awards, Caltrans can monitor how its project delivery process is affecting the construction market. For example, if projects are let too quickly, then number of bidders on each project may drop over time or average bid estimates begin to increase.

   b. The Federal Resources Office in the Division of Budgets has detailed engineer's estimates at time of award. The Division of Budgets may be able to provide the detailed bid tabs data required to closely monitor the competitive market in the construction industry.

7. Provide regular progress reports to industry on SB 1 roll out and completions to help contractors and material suppliers forecast their capacity needs

   a. For example, building a real-time dashboard of SB 1 performance metrics, such as revenues allocated and revenues awarded by district, project work type, funding account source, among other project attributes would significantly aid the industry in planning their capacity needs six months, two years or even five years into the future. Dashboard would be updated on a monthly basis, showing historical, current and forecasted allocated revenues or awards.

Appendix A

Construction Contractor Survey Methodology and Report

Executive Summary

The objective of the survey was to collect first-hand knowledge to date of demand and supply conditions from construction contractors who have bid on Caltrans highway and bridge projects during the last 10 years. The questionnaire aimed to identify and assess the constraints on the procurement process that could affect project delivery. HDR administered the SB 1 Impact on Construction Cost Escalation Survey for Construction Contractors online starting on August 21, 2019, and ending on September 30, 2019. HDR invited a total of 1,308 construction contractors to complete the survey. A total of 204 email addresses were no longer active, so only 1,110 firms received the invitations. Overall the response rate for the survey was 7.6%.

Key Findings

- Most construction contractors are involved in heavy or highway construction (75%) and paving businesses (54%).
- Most respondent firms have at least some familiarity with SB 1. Specifically, 59% of respondent firms said that they are familiar with SB 1, and 30% are somewhat familiar with SB 1.
- Construction contractors pursued 78 projects (median) during July 2018 to June 2019 (mean of 147 projects), and 5 of these projects (median) were funded by SB 1 (mean of 16 projects).
- Although 46% of construction contractors noticed an increase in the total number of projects they pursued during the current fiscal year (July 2018 to June 2019) compared to the previous fiscal year (July 2017 to June 2018), 32% said that there had been no real change during that period.
    - Forty-eight percent of respondents said that this year-over-year change in the number of projects they pursued was larger than the changes observed in recent years (2013 to 2016).
- Construction contractors worked on 25 projects (median) during July 2018 to June 2019 (mean of 207 projects), and 3 of these projects (median) were funded by SB 1 (mean of 11 projects).
- Although 42% of construction contractors said that the number of projects they had completed or actively worked on during the current fiscal year (July 2018 to June 2019) had increased since the previous fiscal year (July 2017 to June 2018), 37% stated that their workloads had not really changed.
    - Fifty-three percent of respondents said that this year-over-year change in the number of projects they worked on was larger than the changes observed in recent years (2013 to 2016).
- The majority of the firms (95%) said that they would consider bidding on future SB 1 funded projects.

- Construction contractors said that the largest construction labor categories on their payroll were construction and extraction occupations, followed by management occupations. In particular, construction and extraction occupations constituted 61%–65% of the overall payroll, while management occupations constituted about 6%–10% of the overall payroll.
- Since 2018, construction contractors observed skill shortages mostly in construction and extraction occupations and management occupations, and 21% of the responding firms only attributed some of the skill shortages to SB 1.
- Most of the responding firms intend to expand their workforce in the next 5 years, and the median percentage increase ranged around 11% to 15%. Construction and extraction occupations are expected to experience the largest expansion, followed by occupations in management and in transportation and material moving.
- Since 2018, most firms (91%) experienced an increase in their overall wages, with a median wage increase of 4%. Furthermore, 82% of the firms expect to increase their overall wages in the next year, with the median expected increase of 4%. For the wage changes, 26% of construction contractors attributed some the changes to SB 1.
- The majority of the surveyed firms (64%) said that, since 2018, they had experienced shortages or delays when ordering highway and/or bridge construction materials. These shortages or delays did not stop the majority of the firms (76%) from bidding on projects since 2018 but did cause a schedule disruption.
    - An increased demand due to the growing number of infrastructure projects (72%) and increased demand due to the growing economy (68%) were the two reasons most selected as reasons for supply shortages or delays.
- Eighty-one percent of firms expect supply shortages or delivery delays of construction materials in the future (2019–2027). The top two materials that would have supply shortages or delivery delays were asphalt (65%) and concrete (65%).
- None of the firms had experienced a decrease in the unit cost for all construction materials since 2018. Asphalt (67%) and concrete (77%) were the top two materials that experienced an increase in unit cost since 2018, with a median increase of 6% to 10%. Moreover, asphalt (71%) and concrete (71%) were also the top two materials expected to experience a unit price increase next year.
- Thirty-five percent of the firms that had at least some familiarity with SB 1 and noticed a price change attributed some of the changes in the unit costs of materials to SB 1.

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Acronyms and Abbreviations

Caltrans	California Department of Transportation
CARB	California Air Resources Board
CMGC	construction manager/general contractor
Freq.	frequency
Q	question
ROW	right-of-way
SB	Senate Bill

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1 Introduction

HDR conducted multiple surveys in California on behalf of the California Department of Transportation (Caltrans). Caltrans is interested in understanding how increasing infrastructure funding from Senate Bill 1 (SB 1) will affect future highway and bridge construction costs. The goal of SB 1 is to address a backlog of repairs and upgrades to the transportation system while ensuring a cleaner and more sustainable travel network for the future. The funding program will do so through investing $5.4 billion annually to repair California's transportation system.

Although the overall study conducted by HDR seeks to understand the effects of SB 1, one of the surveys was conducted to understand the effects that SB 1 will have on demand and supply conditions according to construction contractors through their first-hand experience and knowledge. This report presents the findings of that survey (the SB 1 Impact on Construction Cost Escalation Survey for Construction Contractors) and discusses the expected effects of SB 1 as predicted by a sample of construction contractors in California.

The survey collected construction contractors' perceptions regarding the available workforce as well as the change in labor wages. The effects on unit prices and the availability of highway and bridge construction materials as observed by the contractors were investigated through the survey tool. Most importantly, the survey asked, through means of open-ended questions, the possible reasons why or why not contractors would bid on future SB 1 projects once they are let. The reasons cited could be, but are not limited to, shortages of skilled employees, lack of availability of construction materials, change in material costs, and/or shipping delays. The responses provided by the participating contractors, when aggregated, show a picture of the current state of the highway and bridge construction industry as of mid-2019 from their perspective.

The remainder of this report is divided into the following sections:

- *Section 2 – Survey Methodology* provides an overview on the survey and how the data were collected.
- *Section 3 – Survey Results* identifies the number of valid responses received for each question.
- *Section 4 – Summary of Findings and Conclusions* summarizes relevant findings and conclusions drawn from the survey results.

2 Survey Methodology

The objective of the survey was to collect first-hand knowledge to date of demand and supply conditions from construction contractors who have bid on Caltrans highway and bridge projects during the last 10 years. Specifically, the survey assessed the possible effects from SB 1 on the overall supply and demand in the construction industry and whether Caltrans' roster of contractors in California have the capacity to bid on the volume of work anticipated over the next 10 years.

2.1 Sampling Frame

In order to invite targeted construction contractors to complete the survey, HDR prepared a list of the construction contractor firms' names, phone numbers, and email addresses using bid tab data provided by Caltrans. The list included construction contractors who bid on projects during the last 10 years. In total 1,308 construction contractors were invited to complete the survey.

2.2 Questionnaire Development

The objective of the survey questionnaire was to identify and assess the constraints on the procurement process that could affect project delivery. The questionnaire asked respondents to estimate the number of projects pursued during July 2018 to June 2019 and how many of these projects were funded by SB 1. In a similar manner, the questionnaire asked respondents to estimate the number of projects they worked on during July 2018 to June 2019 and how many of these projects were funded by SB 1. The questionnaire also asked respondents to provide the construction labor categories that make up their payroll, and in which of these construction labor categories have they observed skill shortages since 2018.

Respondents were also asked whether they have experienced a shortage or delay when ordering construction materials since 2018. In order to better understand the effect of SB 1 on the cost of materials from the perspective of construction contractors, the questionnaire asked respondents whether they have observed a trend in unit costs for construction materials, and how much of this change (if any) can be attributed to SB 1.

The questionnaire for construction contractors who have bid on Caltrans' projects consists of five components:

- *Section A – Your Firm*: Construction contractor firm details
- *Section B – Your Projects*: Details of the number of pursuits and projects during July 2018 to June 2019 and how this number compares to the number of pursuits and projects during July 2017 to June 2018 and in recent years (2013–2016)
- *Section C – Your Workforce*: Respondents' current workforce and their observed skill shortages since 2018, if any
- *Section D – Supply of Materials or Products*: Construction contractors' experience with shortages or delays when ordering highway or bridge construction materials since 2018

- *Section E – Costs of Materials/Products*: Respondents' observed trend in unit costs for materials and products since 2018.

The final questionnaire used in the survey is included in Appendix A of this report.

2.3 Survey Administration

HDR administered the SB 1 Impact on Construction Cost Survey for Construction Contractors online through SurveyMonkey[1] starting on August 21, 2019, and ending on September 30, 2019. This survey was intended to help Caltrans understand the perceived effects of SB 1 according to construction contractors in California.

The survey was sent to 1,314 California construction contractors. A total of 204 email addresses were no longer active, so only 1,110 firms received the invitations. These invitations also included phone numbers and email addresses for HDR and Caltrans in case the respondents had questions or concerns about the survey. Email reminders were sent to those who had not completed the survey on September 4, 2019. All of the online responses were automatically saved in a database format as SPSS[2] (Statistical Package for Social Sciences) files with fixed record layouts.

As shown in Table 1**,** the survey was initiated by 84 respondents, but only 48% of the respondents completed the survey. Although the remaining 52% did not complete all the questions in the survey, the questions that were completed contributed to the overall survey analysis. The data from the 84 respondents to the survey are sufficient to provide trending insights about the industry and how it has been affected by SB 1 to date. It might be premature to extrapolate survey results to all 1,110 firms invited to complete the survey. Note that the approximate 7.6% response rate (84/1,110) from this survey falls in line with the typical response rate for online surveys, which ranges from 5% to 30%.[3]

Table 1. Number of Completed and Partially Completed Surveys

Survey Type	Number	Percentage
Completed surveys	40	47.6%
Partially completed surveys	44	52.4%
Total surveys	**84**	**100.0%**

[1] SurveyMonkey Inc., San Mateo, California, USA, main website: http://www.surveymonkey.com.

[2] IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

[3] "What's a Typical Survey Response Rate?", Aaron Jue, FocusVision, April 24, 2019. Link: https://www.focusvision.com/blog/whats-a-typical-survey-response-rate/.

3 Survey Results

This section summarizes the responses to the survey by construction contractors with the results presented by section. Each table highlights the number of valid survey responses received for each question, as well as the valid percentage frequency for each response. The valid percentage frequency is based on the number of respondents who answered each question. If eligible respondents skipped a question, the count is recorded in the tables below as "No answer" for information purposes. Finally, if fewer than five respondents selected a response category for a given question, the question's tabulation is either collapsed or entirely suppressed to protect the respondents' confidentiality, and only percentages are shown.

3.1 Section A – Your Firm

Table 2 and Table 3 present the responses for Section A of the questionnaire. The results showed that the respondent firms ranged in size significantly – the smallest firm reported only 2 employees and the largest reported 20,000 employees (Q5). The median number of employees provided by respondents was 100 (Q5). Moreover, the responses showed that only 29% of respondent firms are classified as Small Business (SB)/ Disabled Veteran Business Enterprise (DVBE)/Disadvantaged Business Enterprise (DBE) (Q6). Firm revenues (Q7) also ranged in amounts such that about a third had annual revenues less than $25 million, nearly 40% had revenues between $25 million and $250 million, and 29% had revenues of $250 million or more. This range suggests a good representation of small, medium, and large construction firms.

The results showed that 75% of respondent firms are involved in heavy or highway construction and 54% of firms are in the paving business (Q9). The following other construction categories were stated in response to Question 9:

- Asphalt recycling and stabilization
- Civil engineering, stormwater management
- Construction materials supply
- Equipment supplier for hot mix asphalt (HMA)
- Fire life safety – heating, ventilation, and air conditioning (HVAC)
- Foundations, right-of-way (ROW) clearing
- Highway landscaping, city and county streets and parks
- Landscaping with some concrete, utility, drainage, etc.
- Polyester overlays, method deck treatment, and high friction surface treatments (HFST)
- Reinforcing steel
- ROW clearing
- Subcontractor
- Systems – conveyers, controls.

The majority of the respondents said that they are primarily prime contractors (53%), while 36% of respondents said that they are sometimes prime contractors and sometimes subcontractors (Q10).

Table 3 also shows that the top three types of projects on which the respondents bid are maintenance or repair for state highway (84%), new construction for local roads (82%), and new construction for the state highway system (79%) (Q11). Respondents also said that they bid on the following types of construction projects:

- All private asphalt projects – housing tracts and commercial
- We don't bid on projects, we provide equipment
- Design
- Drainage improvements
- Electrical only for all the above
- Federal projects such as levees, Federal Highway Administration (FHWA), U.S. Army Corps of Engineers (USACE), military bases
- State and local agency highway and road rehabilitation, widening, and overlays
- Transportation Management Center (TMC) and maintenance Emergency Operations Centers (EOC) video wall projects
- Traffic control and signage
- Tunnel fire life safety ventilation
- Water treatment plants.

Furthermore, 55% of respondents who answered Question 12 said they pursued projects with construction manager/general contractor (CMGC) as the project delivery method, and 53% said they pursued projects with design-bid-build as the project delivery method. Respondents said they pursued projects with other project delivery methods including:

- Bid
- Bid-build
- Bid, request for proposal (RFP)
- Construction manager at risk (CMAR)
- Competitive bidding
- Competitive bid – public works
- Concrete work and underground
- Construction management
- Hard bid
- Low-bid public works, also known as "rip and read"
- Prime contractor on local agency (central valley) project involving paving, grading, and concrete work
- Public bid opening
- Quote advertised projects for State, City, County, etc.
- Unit price competitive bid.

Table 2. Construction Contractors' Number of Employees

Question		Responses	Valid Responses
Q5	**Current number of employees:**	N	68
		No answer	16
		Mean	685
		Median	100
		Maximum	20,000
		Minimum	2

Table 3. Construction Contractors' Firm Details

Question		Responses	Valid Responses	Freq.
Q6	**Do you have SB/DVBE/DBE number?**	No	60	71%
		Yes	24	29%
		No answer	0	NA
Q7	**If "Yes" to Q6, please indicate which one**	SB	18	75%
		DVBE / DBE	6	25%
		No answer	0	NA
Q8	**Total Company Revenue Range**	Under $10 million	12	16%
		$10–$25 million	14	18%
		$25–$50 million	14	18%
		$50–$100 million	9	12%
		$100–$250 million	6	8%
		$250 million and over	22	29%
		No answer	7	NA
Q9	**Which construction categories below describe your firm? You can select more than one if applicable.**	Heavy/Highway	61	75%
		Paving	44	54%
		Underground Utility/Drainage	34	42%
		Concrete Flatwork	34	42%
		Bridge Construction	33	41%
		Wall Construction	32	40%
		Bridge Grading	26	32%
		Municipal/Utility	20	25%
		Commercial	16	20%
		Traffic Signals	13	16%
		Intelligent Transportation/ Advanced Traffic Management Systems	11	14%
		Residential	7	9%
		Other	13	16%
		No answer	3	NA
Q10	**Are you primarily a prime contractor or a subcontractor to a lead firm? Please select one.**	Prime	40	53%
		Sometimes prime, sometimes subcontractor	27	36%
		Subcontractor	9	12%
		No answer	8	NA
Q11	**What types of highway/bridge construction projects does your firm bid on? Please select all that apply.**	Maintenance/Repair for local roads	52	78%
		Maintenance/Repair for state highway system	56	84%

Question		Responses	Valid Responses	Freq.
		Maintenance/Repair for state bridge and culvert	48	72%
		Expansion for local roads	51	76%
		Expansion for state highways system	49	73%
		Expansion for state bridge and culvert	45	67%
		New construction for local roads	55	82%
		New construction for state highway system	53	79%
		New construction for state bridge and culvert	48	72%
		Other for state highway system	10	15%
		Other for local roads	9	13%
		Other for state bridge and culvert	9	13%
		Other	12	18%
		No answer	17	NA
Q12	**What method of project delivery does your firm pursue? Please select all that apply.**	CMGC (Construction Manager/General Contractor)	41	55%
		Design-bid-build	39	53%
		Design-build	32	43%
		Not applicable	8	11%
		Other	16	22%
		No Answer	10	NA

3.2 Section B – Your Projects

Section B of the questionnaire asked the respondents to provide the number of projects pursued and total projects.

As shown in Table 4, when asked whether they were familiar with SB 1, 59% of the respondents said that they were familiar with SB 1, and 11% of respondents were not familiar with SB 1.

Table 4. Construction Contractors' Familiarity with SB 1

Question		Responses	Valid Responses	Freq.
Q13	**Are you familiar with infrastructure funding through California's Senate Bill 1 (SB 1) investments?**	Yes	44	59%
		Somewhat familiar	22	30%
		No	8	11%
		No answer	10	NA

Table 5 shows that number of projects that respondents pursued between July 2018 and June 2019 ranged from 0 to 2,500, with an average of 147 projects.

Table 5. Number of Projects Pursued during July 2018 to June 2019

Question		Responses	Valid Responses
Q14	**How many projects (approximately) did your firm pursue during July 2018 to June 2019?**	N	58
		No answer	26
		Mean	147
		Median	78
		Maximum	2,500
		Minimum	0

The number of pursued projects that were funded by SB 1 ranged from 0 to 100, with a median number of 5 projects that were funded by SB 1, as shown in **Error! Not a valid bookmark self-reference.**.

Table 6. Number of Projects Pursued during July 2018 to June 2019 Funded by SB 1

Question		Responses	Valid Responses
Q15	**If a, b in Q13, how many of these projects were funded by SB 1?**	N	47
		No answer	19
		Mean	16
		Median	5
		Maximum	100
		Minimum	0

Question 16 asks whether the number of total projects pursued increased or decreased compared to the projects pursued during July 2017 to June 2018. As shown in Table 7, 46% of respondents noticed an increase in the total number of project pursued. Meanwhile, 33% of respondents experienced no change in the total number of projects pursued.

Table 7. Change of Projects Pursued Compared to July 2017 to June 2018

Question		Responses	Valid Responses	Freq.
Q16	**Has the number of your total projects pursued increased or decreased compared to the projects you pursued during July 2017 to June 2018?**	Has increased	29	46%
		No change	20	32%
		Has decreased	14	22%
		No answer	21	NA

Question 17 asks how the change in projects pursued, according to Question 16, compared to changes observed in recent years (2013 to 2016). Table 8 shows that about 40% of respondents said it was about the same, while 48% said that this change was larger than in recent years.

Table 8. Change in Current Year-Over-Year Projects Pursued Compared to Changes in Recent Years

Question		Responses	Valid Responses	Freq.
Q17	**How does this change in projects compare to changes observed in recent years (i.e., 2013 to 2016)?**	This change is larger than in recent years	30	48%
		About the same	25	40%
		This change is smaller than in recent years	8	13%
		No answer	21	NA

Table 9 presents the number of projects that respondents worked on during July 2018 to June 2019 (Q18). The results show that the number of projects respondents had worked on during July 2018 to June 2019 ranged from 0 to 6,000 projects, with the median number of projects at 25.

Table 9. Number of Projects Worked on During July 2018 to June 2019

Question		Responses	Valid Responses
Q18	**How many projects (approximately) did your firm work on during July 2018 to June 2019?**	N	54
		No answer	30
		Mean	207
		Median	25
		Maximum	6,000
		Minimum	0

Although Table 9 above shows the total number of projects respondents worked on, **Error! Not a valid bookmark self-reference.** shows how many of those projects were funded by SB 1 (Q19). The results show that the number of projects respondents worked on from July 2018 to June 2019, and which were funded by SB 1, ranged from 0 to 100, with a median number of 3 projects.

Table 10. Number of Projects Pursued During July 2018 to June 2019 That Were Funded by SB 1

Question		Responses	Valid Responses
Q19	**If a, b in Q13, how many of these projects were funded by SB 1?**	N	41
		No answer	25
		Mean	11
		Median	3
		Maximum	100
		Minimum	0

Question 20 shows how the current total number of project respondents worked on during July 2018 to June 2019 changed relative to the period July 2017 to June 2018. As seen in Table 11, 42% of respondents said that they experienced an increase in the total number of projects, while 37% said there was no change.

Table 11. Change in Total Projects Since July 2017 to June 2018

Question		Responses	Valid Responses	Freq.
Q20	**Has the number of your total projects increased or decreased compared to the projects you had during July 2017 to June 2018?**	Has increased	24	42%
		No change	21	37%
		Has decreased	12	21%
		No answer	27	NA

Question 21 asked respondents how these current year-over-year changes compared to the changes observed in recent years (2013 to 2016). Table 12 shows that 55% of the respondents said that this change was larger than in recent years, while 34% of the respondents said that the change in the total number of projects was about the same.

Table 12. Change in Current Year-Over-Year Total Projects Compared to Changes in Recent Years

Question		Responses	Valid Responses	Freq.
Q21	**How does this compare to changes observed in recent years (i.e., 2013 to 2016)?**	This change is larger than in recent years	31	55%
		About the same	19	34%
		This change is smaller than in recent years	6	11%
		No answer	28	NA

When asked whether respondents were actively pursuing any existing SB 1 funded projects and planning to submit a bid, 56% of respondents said that there were such projects, as shown in Table 13. Comparatively, 12% of respondents were not currently pursuing or planning to submit bids.

Table 13. Number of Projects Actively Pursuing Funded by SB 1

Question		Responses	Valid Responses	Freq.
Q22	**If a, b in Q13, Are there any existing let SB 1 funded projects your firm is actively pursuing and planning to submit a bid?**	Yes	30	56%
		Don't know	18	33%
		No	7	12%
		No answer	11	NA

Table 14 shows the number of SB 1 funded projects that respondents are considering bidding on. The number of projects being considered ranged from 2 to 100 projects, with the average number of projects considered being 17 projects.

Table 14. SB 1 Funded Projects Firms Are Considering

Question		Responses	Valid Responses
Q23	**If "Answer = Yes in Q22", Approximately, how many of such projects is your firm considering?**	N	24
		No answer	6
		Mean	17
		Median	5
		Maximum	100
		Minimum	2

Finally, when asked whether respondents were considering bidding on future SB 1 funded projects in Question 24, the majority of the respondents (95%) who answered this question were considering bidding, while the remainder were unsure. Due to the low number of responses, the question's tabulation was suppressed to protect the respondents' confidentiality.

3.3 Section C – Your Workforce

Section C of the questionnaire asked the construction contractors to provide details regarding the type of personnel and professionals they employ, and whether they were experiencing any staff shortages. In particular, this section first presents a breakdown of a firm's payroll by different labor categories using the percentage categories in Table 15 at right.

Table 16 below shows the median responses by each type of construction labor category that construction contractors firms have on their payroll. The median percentage of staff on payroll belonging to "Construction and Extraction Occupations" was 61% to 65%. The remaining labor categories ranged from 2% to 6%–10% of payroll.

The "Other" labor category made up about 5% of the total payroll of the responding firms. Examples of "Other" labor categories, as stated by respondents, are:

- Traffic control, signage production, equipment, plans specialist, training, supervision, and management
- Office/administration sales warehouse
- Corporate
- Carpenters and laborers
- Asphalt and aggregate producer.

Table 15. Payroll Percentage Categories

Percentage Categories
0%
1%
2%
3%
4%
5%
6%–10%
11%–15%
16%–20%
21%–25%
26%–30%
31%–35%
36%–40%
41%–45%
46%–50%
51%–55%
56%–60%
61%–65%
66%–70%
71%–75%
76%–80%
81%–85%
86%–90%
91%–95%
96%–100%

Table 16. Construction Labor Categories on Payroll

Question		Responses	Valid Responses	Median Category
Q26	**Please provide a breakdown of the types of construction labor categories your firm has on payroll using percentages. If you don't have any in a category, please enter 0.**	Construction and Extraction Occupations	47	61%–65%
		Business and Financial Operations Occupations	37	5%
		Management Occupations	36	6%–10%
		Transportation and Material Moving Occupations	34	5%
		Architecture and Engineering Occupations	34	2%
		Installation, Maintenance, and Repair Occupations	30	2%–3%*
		Production Occupations	28	2%–3%*
		Other	11	5%
		No answer	40	NA

* Categories were collapsed to protect respondents' confidentiality.

Table 17 shows the observed skill shortages from the perspective of the respondents. The results show that 79% of respondents have either experienced or observed a shortage of staff in "Construction and Extraction Occupations." Meanwhile, the top two occupation categories in which respondents have not experienced or observed shortages were "Architecture and Engineering Occupations" (53%) and "Business and Financial Occupations" (42%). Respondents also experienced or observed shortages in the following "Other" occupations:

- Carpenters/laborers
- Laborers
- Skilled labor for asphalt and aggregate plant operators.

Table 17. Observed Skill Shortages Since 2018

Question		Responses	Valid Responses*		Freq.
Q27 Part A	**Please indicate if you have observed skill shortages since 2018 by construction labor categories.**	Construction and Extraction Occupations (e.g., construction laborers, cement masons and concrete finishers, paving, surfacing, and tamping equipment operators, etc.)	Yes	34	79%
			No	8	19%
		Business and Financial Operations Occupations (e.g., cost estimators)	Yes	12	28%
			No	18	42%
		Management Occupations (e.g., construction managers)	Yes	22	51%
			No	12	28%
		Transportation and Material Moving Occupations (e.g., truck and tractor operators, drivers, freight/stock laborers, etc.)	Yes	25	58%
			No	9	21%
		Architecture and Engineering Occupations (e.g., civil, electrical engineers/technicians, etc.)	Yes	7	16%
			No	23	53%
		Installation, Maintenance, and Repair Occupations (e.g., industrial machinery mechanics, electrical power line installers, telecommunications installers, etc.)	Yes	10	23%
			No	17	40%
		Production Occupations (e.g., welders, solderers, tool setters, etc.)	Yes	10	23%
			No	17	40%
		Other	Yes	3	7%
			No	6	14%
		No Answer		41	NA

* Respondents were allowed to select multiple categories.

The second part of Question 27 asked respondents to provide examples of specific jobs their firms had difficulty staffing. Overall, the respondents listed a vast range of occupations or positions for which they struggled to find qualified candidates. These positions were not limited to low-skill positions. Some respondents have struggled to find candidates for high-skill positions (e.g., one respondent had trouble finding a chief financial officer). The complete list of comments per labor category is provided in **Error! Reference source not found.**.

Table 18 lists the responses to Question 28, which asked respondents the most important factors causing the labor shortages. Respondents said that the most important factor was the lack of skilled operators, while the next most frequent factors were the competition for the limited number of skilled workers. Other than those prominent reasons, respondents attributed the shortages to various other factors, such as the inability to provide wages competitive to firms that offer private contracting work and the attractiveness of unions.

Table 18. Factors Causing Labor Shortage

Question		Responses
Q28	**For the labor categories where you have indicated shortages, would you able to list the most important factors causing the labor shortages?**	Camp fire, car fire took a substantial amount of skilled labor away from highway work.
		Competition for limited number of skilled workers.
		Competition for limited numbers of workers, unable to provide better wages than companies that do private contracting.
		Competition for limited skilled workers. We are non-union, so quality employees leave us for the unions.
		Could not meet the women/apprentice rates needed for some projects.
		Labor shortage and journey level skillset.
		Lack of Journey level skillset.
		Lack of skilled labor.
		Lack of skilled labor and a lack of apprentices.
		Lack of skilled operators.
		Most of the available people are not skilled enough, or capable of doing the work.
		Need more journeyman and skilled labor. We fill spots with labors but journeyman are overworked.
		No enough skilled workforce. Young generations not pursuing the trades.
		Not enough interested in skilled labor, State approved apprenticeships being ONLY union; lack our journey level skillset.
		Not enough skilled labor lack of journey level skillset.
		Not enough skilled labor and competition.
		Not enough skilled labor, pay required is over scale.
		Not enough skilled labor. We have a lot of young people apply without any degrees or skills related to the job.
		Not enough skilled labor. Not enough programs for young people who do not plan to attend college, seeking a career right out of High School.
		Not enough skilled people.

Question		Responses
		Not enough skilled workers. Equipment operators is of the worst. The older generation is retiring whereas the younger operators are far less skilled or trained thus increasing company risk.
		Skilled Labor and Skilled Operators. The current generation is lazy. People don't want to work for a living. The work is too hard, too stressful, too demanding. Don't think the benefits of working in the industry are advertised enough. But in general, I think that young workers are not attracted to the work, or don't understand the demand for young talented persons on the labor and managerial side.
		Skilled labor shortage, foolish Caltrans Certification requirement where our experienced staff is getting trained by less experienced trainers.

When respondents were asked how much the labor shortages can be attributed to SB 1 (Q29), 41% of the respondents were not sure about the effects SB 1 had on labor shortages, while 31% attributed none of the labor shortages to SB 1. In contrast, 21% of respondents attributed some of the shortages to SB 1. Note that, due to the limited responses for some of the choices of this question, and in order to ensure respondent confidentiality, this question is not tabulated.

In addition, respondents were given the opportunity to expand on their responses, with the comments presented in Table 19. One respondent said that the labor shortages were not driven by SB 1 since the industry was like this prior to SB 1. Instead, this respondent attributed the shortages to a combination of an aging workforce and the younger generation not being willing or wanting to work in the construction industry. In contrast, another respondent said that SB 1 affected the workforce because of the increased amount of work available to bid and build.

Table 19. Labor Shortages Attributed to SB 1 – Comments

Question		Responses
Q29 Part B	**If you would like, please feel free to elaborate on your response.**	I do believe Caltrans needs to evaluate how many projects a year that should be put out to bid. In District 6 for example we have a limited amount of aggregate that can be produced to support both Private and Public works projects.
		I don't believe it's due to SB 1 as the industry was like this prior to SB 1. Our workforce is aging and the younger generation is not willing or wanting to come to work in the construction industry. Our unions are doing a poor job of recruiting and training the workforce making it even more difficult to find and or develop the skilled labor needed.
		I don't feel SB 1 is causing the labor shortage. It's more related to years of students being pushed to college, even if they weren't college material. The trades pay well and should be encouraged as a viable option.
		It is just a shortage, I have call the union hall and sometimes there is nobody in the hall and the couple guys they have are there for not been that good.
		Only affected by SB 1 because if increase amount of work to bid and build.
		SB 1 projects are not causing the shortage. There are only a small number.
		The market is flooded with both current public work, private work a new SB 1 work coming to bid.
		The overall industry is facing a shortage in skilled labor. Contractors are being forced to pay extremely high wages due to the scarcity.
		The work was not available before SB 1 was in place. Skilled workers retired or moved on to other professions. But with SB 1, people are returning to the industry.
		We are just expanding into public work so we are not really impacted but with bigger firms bidding public works, it leaves the commercial market open for us.
		We had shortages in our work force prior to SB 1, so I don't think our shortages are due to SB 1.

Question 30 asked respondents whether they planned to expand their firm's workforce in the next five years. As shown in Table 20, the majority of respondents (85%) said that they intended to expand their workforce in the next five years, with a median percentage increase of 11% to 15%.

Table 20. Intent to Expand Firm's Workforce

Question		Responses	Valid Responses	Freq.
Q30	**Do you intend to expand your firm's workforce in the next five years? Please select one.**	Yes, Increase of _____ percent	41	85%
		No Change, Decrease, or Don't Know	7	15%
		No answer	36	NA

Table 21 shows the median responses by each construction labor category that respondents expect will experience more expansion. The median percentage of staff belonging to the "Construction and Extraction Occupation" that is expected to experience more expansion in the next five years is 16% to 20%. The remaining categories are expected experience a growth in the workforce that ranges from 0% to 10% in the next five years. "Other" construction labor categories provided by respondents are:

- Asphalt and aggregate plant operators
- Traffic control and equipment sales/rental.

Table 21. Workforce Expansion by Construction Labor Category

Question		Responses	Valid Responses*	Median Category
Q31	**Within the overall construction labor workforce, what labor category do you expect will experience more expansion and by what percentage of growth in the workforce over the next five years? Please select all that apply.**	Construction and Extraction Occupations (e.g., construction laborers, cement masons and concrete finishers, paving, surfacing, and tamping equipment operators, etc.)	32	16%–20%
		Management Occupations (e.g., construction managers)	23	6%–10%
		Business and Financial Operations Occupations (e.g., cost estimators)	21	5%
		Transportation and Material Moving Occupations (e.g., truck and tractor operators, drivers, freight/stock laborers, etc.)	21	6%–10%
		Architecture and Engineering Occupations (e.g., civil, electrical engineers/technicians, etc.)	18	5%
		Installation, Maintenance, and Repair Occupations (e.g., industrial machinery mechanics, electrical power line installers, telecommunications installers, etc.)	17	0%

Question		Responses	Valid Responses*	Median Category
		Production Occupations (e.g., welders, solderers, tool setters, etc.)	15	0%
		Other	7	0%
		No answer	48	NA

* Respondents were allowed to select multiple categories.

As shown in Table 22, 91% of the respondents who answered Question 32 experienced an increase in overall wages since 2018, while 9% of respondents either did not experience a change in overall wages or experienced a decrease in overall wages. For those respondents who stated on overall wage increase, the median percentage of the increase was 4%.

Table 22. Change on Overall Wages Since 2018

Question		Responses	Valid Responses	Freq.
Q32	**What was the percent change in your firm's overall wages since 2018? Please select one**	Increase of _____percent	40	91%
		No change or decrease	4	9%
		No answer	40	NA

As shown in Table 23**,** 82% of the respondents who answered Question 33 expected an increase in their overall wages during the next year, with the median expected wage increase of 4%.

Table 23. Future Change on Overall Wages

Question		Responses	Valid Responses	Freq.
Q33	**Do you think overall wages will change next year, and if so by what percentage? Please select one.**	Increase of _____ percent	36	82%
		No change, decrease, or don't know	8	18%
		No answer	40	NA

When asked in Question 34 how much of the wage changes can be attributed to SB 1, 36% of the respondents said that none of the wage changes could be attributed to SB 1, and 33% were unsure whether SB 1 had any effects driving the wage changes. In contrast, 26% of respondents said that SB 1 had some effects on the wage changes. Due to the limited valid responses across all possible response choices, the results were not tabulated.

In addition, respondents were provided an opportunity to elaborate their answers, as shown in Table 24. One of the respondents said that, as their firm is unionized, they expected to see an annual wage increase regardless of outside factors such as government funding. Meanwhile, another respondent said that, with an abundance of new work coming to the market, there will be an increase in market competition.

Table 24. Wage Changes Attributed to SB 1 – Comments

Question		Responses
Q34 Part B	**If you would like, please feel free to elaborate on your response.**	I don't believe it's a result of SB 1 but a result of the shortage in skilled labor.
		If we see more work bidding and some kind of pipeline to be able to forecast any future projects bidding.
		Union contracts remain steady at 3% to 4%. However, due to the shortage in the industry it is routine to pay over scale.
		We are a union company. Union workers get a wage increase every year regardless of funding types by the State, Federal Govt, or Local Agency or the type and amount of work we do.
		With an abundance of new work coming to the market there will be an increase in market competition.

3.4 Section D – Supply of Materials or Products

Section D of the questionnaire asked respondents to provide detailed information regarding supply shortages or delays that they have experienced in recent years. As shown in Table 25, 64% of the respondents have experienced a shortage or delay when ordering highway and/or bridge construction materials.

Table 25. Shortages or Delays of Highway/Bridge Construction Materials

Question		Responses	Valid Responses	Freq.
Q35	**Has your firm experienced shortages or delays when ordering highway/bridge construction materials such as asphalt, cement, ready-mix concrete, steel or components such as lighting or intelligent transportation systems since 2018?**	Yes	28	64%
		No	16	36%
		No answer	40	NA

Table 26 lists the examples, provided by respondents, of instances in which materials or products were in short supply or delayed since 2018. For the asphalt category, the general comments indicated that production companies were experiencing high demand, which required respondents to improve their planning and increase their lead times. This was also similar for the concrete and steel categories; respondents said there was a shortage of the material and a need for advance scheduling to avoid project delays. In regard to concrete, one respondent said that "what once used to require 3 days' notice, now takes about 3 weeks' notice." Similarly, for steel, a respondent said that requests needed to be made 2 to 3 weeks early in order to avoid project delays.

For cement, respondents reported a shortage of fly ash due to less fossil energy production and a lack of transportation. Meanwhile, for "Other" materials, a respondent said that the shortage of truck drivers has been a major factor in completing projects.

Table 26. Examples of Materials/Products in Short Supply Since 2018

Question		Materials/Products	Responses
Q36	**Are you able to provide examples of materials/products which were in short supply or delayed at the time your firm planned or needed to have the material/product available since 2018? Please provide as many examples with estimate of quantity if you can.**	Asphalt	all asphalt companies are impacted so lead times are longer
			availability of asphalt due to larger paving companies has made us adjust and pave nights
			CT is using rubberized HMA in quantities that far exceed the availability of rubber blending plants
			daily - work force
			For example we have a 600,000 tn AC project which will tie up one of our plants for the next 3 years at night and make it difficult to do any other projects in the area.
			Increased planning and advanced scheduling is required
			liquid asphalt due to less refinery production in CA
			most companies are busy and won't bid on smaller projects
			PG and Emulsion Oils, Rubber Plants, Shuttle Buggies, Lime, and Hot Plant Overall Availability
			Polymer Modified Asphalt
			The plant was booked and had to schedule two to three weeks in advance,
		Cement	actually, fly ash due to less fossil fuel energy production
			Lack of transportation
			Proper scheduling has prevented any issues
		Concrete	cement companies are running out of fly ash due to coal production. everyone is fighting for more flash
			concrete is always really late
			daily

Question	Materials/Products	Responses
		Have to schedule 2 weeks in advance
		Increased planning and advanced scheduling is required
		Proper Planning has prevented delays
		ready mixed concrete is a struggle to get on a timely basis; we are scheduling out about a month to get it.
		Shortage of concrete suppliers (trucks and drivers)
		what used to take 3 days' notice now takes 3 weeks' notice to get
	Steel	daily
		epoxy coated rebar, tie and dowel baskets particularly
		limited stock on ground, have to wait for mill rolls
		Shortage of steel suppliers and fabricators
		tariffs posed a large threat to timely delivery though we were able to mitigate through effective procurement methods.
		Traffic and Lighting poles 500+
		You have to request the steel two to three weeks prior to needing the steel or it will delay the project
	Other	500 tons
		Lighting & Signal Poles. Lead times have increased from 6-8 weeks to 5-6 months for Poles
		mulch (recycled yard waste/orchards) - not that we can't get mulch at all, but we can't get enough that meets spec, so agencies are accepting slightly lower grade materials
		Piezo Loops and Many Other Electrical Items
		pipe - over 1000'
		Precast concrete structures are 8-12 lead time to order and if it's a short duration project will cause delays
		TRUCKING -- CARB regulations are driving truckers out of the industry. that coupled with fire cleanup has made for huge shortages in trucking which has driven the price of trucking up nearly 25% in the last 2 years
		Availability of trucks has been a major factor in completing projects.
		electrical signals and equipment - street lights, traffic lights, radar signs, etc.
		Plants, but this is a perpetual problem for landscaping. Agencies don't plan appropriately and expect that their plants will just be stored like pipe, forgetting that they are perishable.

Table 27 shows the responses when respondents were asked whether these shortages or delays affected their firm's decision to bid on projects. Of the 25 who answered the Question 37, 24% said that they had not bid on a project due to construction material shortages or delays, while 76% said that these shortages or delays did not affect their bidding decisions.

Moreover, when asked in Question 38 whether the shortages or delays had disrupted any project schedules since 2018, nearly all (96%) said that the shortage or delay had disrupted the schedule for at least one of their existing projects. This question is not tabulated due to the limited responses for some of the choices and in order to ensure respondent confidentiality.

Table 27. Shortages or Delay Impact on Possible Bids Since 2018

Question		Responses	Valid Responses	Freq.
Q37	**Did this shortage/delay cause your firm not to bid on projects since 2018?**	No	19	76%
		Yes	6	24%
		No answer	59	NA

Question 39 asked respondents what they thought would be the reason for a shortage or delay. As presented in Table 28, 72% of respondents said that increased demand due to the growing number of infrastructure projects was the main reason for the shortage or delay of supplies. Meanwhile, 68% of the respondents felt that the increased demand due to growing economy could explain the shortages, and 36% said that difficulties sourcing materials as well as truck driver shortages were reasons for supply shortages or delays. Other reasons provided by respondents were:

- Tariffs
- California environmental regulations
- Only 2 sources for signal and lighting poles approved by Caltrans
- Overall lack of plants and equipment in California
- Agency scheduling issues. No, we can't just delay 6 months and have your trees stay the same as they were. Those were sold off because otherwise they would have died, so you get what we can source.

Table 28. Reasons for Supply Shortages or Delays

Question		Responses	Valid Responses*	Freq.
Q39	What do you think would be the reasons for this supply shortage/delay? Please select all that apply.	Increased demand due to growing number of infrastructure projects	18	72%
		Increased demand due to growing economy	17	68%
		Difficulties sourcing materials	9	36%
		Truck driver shortages	9	36%
		Producer/supplier changing business operations	8	32%
		Other	8	32%
		No answer	59	NA

* Respondents were allowed to select multiple categories.

Table 29 shows that, of respondents who answered Question 40, 81% anticipate material shortages or delivery delays in the future.

Table 29. Anticipated Short Supply in the Future

Question		Responses	Valid Responses	Freq.
Q40	Do you anticipate short supply or delivery delays of these materials/products in the future (2019-2027)?	Yes	21	81%
		No or Don't Know	5	19%
		No answer	58	NA

As shown in Table 30, the majority of the respondents who answered “Yes” to Question 40 (65%) believed that asphalt or concrete would be in short supply or would experience delivery delays. At a lower frequency than those two categories, 55% believed that steel would face similar issues. As well, 45% of respondents said that other products would be in short supply in the future, but no description of the material was provided. No comments were provided regarding what “Other” materials or products could be in short supply or have delayed deliveries.

Table 30. Construction Materials in Short Supply

Question		Responses	Valid Responses*	Freq.
Q41	Are you able to indicate which of the materials/products you think will be in short supply or have delayed deliveries? Please select all that apply.	Asphalt	13	65%
		Concrete	13	65%
		Steel	11	55%
		Cement	9	45%
		Other	9	45%
		No answer	1	NA

* Respondents were allowed to select multiple categories.

When asked in Question 42 why the materials and/or products listed in Question 41 will be in short supply or could have delayed deliveries, several respondents implied that

these shortages would be due to a lack of qualified truck drivers. Below are other additional comments provided by the respondents:

- Asphalt supply may not meet the demands. Not enough trucking for cement transportation.
- California Air Resources Board (CARB) has forced out a number of trucks from fleets. Quarry permitting is very difficult and with reduced aggregates on the market there will be shortages of concrete and asphalt.
- I did not select steel because we're not having a shortage – we're just paying more due to demand and tariffs. That means everyone's estimates will be higher in the future. Half of our bids this summer were sent to rebid because no one bid at or below the engineer's estimate and I don't see agencies taking these changes into account yet.
- Increased demand. Specs are changing without verifying that availability in the market.
- Limited number of Asphalt Cement (AC) plants and trucking shortage. Dynamex ruling may further complicate the trucking issue. CARB compliance is another issue for truckers.
- Shortage of drivers.
- Shortage of ready-mix trucks.
- Steel costs are up and only 2 pole vendors approved to make California (CA) poles.
- Suppliers going out of business, more demand than supply, changing specifications.

Furthermore, respondents were asked as part of Question 43 how much of a short supply in materials or products could be attributed to SB 1. Only those who responded that they had at least some familiarity with SB 1 and anticipated future supply shortage or delivery delays were asked this question. Based on the responses, 42% said that some of the future shortages and delays could be attributed to SB 1, while 26% said they were not sure about SB 1's effect on the shortages and delays. Due to the limited responses for some of the choices of this question and in order to ensure respondent confidentiality, this question is not tabulated. In addition, no comments were provided for the second part of Question 43.

3.5 Section E – Costs of Materials or Products

Section E asked respondents to provide detailed information regarding trends that they have observed in recent years in the unit costs for construction materials. In general, no respondents had seen a decrease in the unit costs of any materials or products since 2018, nor did they foresee this being the case in the future.

Question 44 asked respondents what types of materials have exhibited increases, decreases, or no change in unit prices since 2018. Thirty respondents answered this question. Many respondents thought that asphalt, cement, concrete, and steel had exhibited price increases since 2018, and their choices are shown in Table 31. Notably,

77% of respondents observed an increase in unit prices for concrete, and 67% observed an increase in unit prices for asphalt.

The median percentage increase for asphalt and concrete fell into the 6% to 10% range, while the median percentage increase for cement was 5%. Steel experienced a median increase since 2018 in the 11% to 15% range. “Other” materials had a 6% to 10% median increase since 2018. Examples of “Other” materials include:

- Polyvinyl chloride (PVC) pipe and other plastics
- Organics plants
- Mulch and compost
- Labor and benefits
- Lighting and signal poles
- Paint
- The overall cost to operate a business has increased in California, permits, yellow iron new CARB laws.

Table 31. Trend in Unit Cost of Construction Materials, Price Increase

Question		Materials	Increase	
			Valid Responses*	Freq.
Q44	**Have you observed an increase in unit costs for these materials/products since 2018? Please indicate by type of material/product whether there has been an increase, and by what percentage amount where relevant.**	Concrete	23	77%
		Asphalt	20	67%
		Cement	16	53%
		Steel	14	47%
		Other	7	23%
		No answer	54	

* Respondents were allowed to select multiple categories.

With respect to materials with no change in unit prices since 2018 (Q44), asphalt was selected by 17% of the respondents as a material that did not experience a price change since 2018. The other materials such as cement, concrete, and steel were selected by 7% to 10% of the respondents. Due to the limited number of valid responses for each response level to this question, the full breakdown is not presented as a table.

Question 45 asked respondents to elaborate why they have seen a change or no change in the unit cost of construction materials since 2018. One respondent said that the change in the cost of construction materials was due to tariffs, while another explained that the combination of increased demand for construction materials and a decline in supply was causing an increase in the unit cost of materials since 2018. All the comments provided in Question 45 are shown in Table 32.

Table 32. Reasons for Changes in Unit Cost of Construction Materials Since 2018

Question		Comments
Q45	**Would you be able to elaborate as to why you have seen a change or no change in unit costs since 2018 for the materials/products you have selected?**	Asphalt demand was up hugely and we don't do a lot of that work so we get surcharged on short loads. Same with concrete. Steel has had tariff surcharges added by our suppliers, plus the cost of freighting heavy materials is up. Plastics and chemical solvents - I dunno, probably environmental regulations and carbon taxing, both of which are good and necessary things, assuming the agencies are prepared for cost increases.
		Asphalt goes up and down based upon the world economy
		for asphalt, increase is due to Caltrans RHMA deductions
		labor cost go up so does product prices
		Supply & Demand. Demand is up and supply is down.
		Tariffs
		The overall costs of doing business in California, permits, labor, yellow iron new carb laws.
		Union increases.

When respondents were asked how unit costs of materials or products would change in the future (Q46), only a few respondents expected the costs to remain the same, and no respondent expected a price decrease in any of the present materials. Rather, a larger proportion of respondents said that they anticipate prices will increase, with the results highlighted in Table 33. Asphalt and concrete were both selected by 71% of the respondents as materials whose prices they anticipate will increase. Beyond those two materials, 57% of respondents also expected cement prices to increase in the next year.

The respondents who expected either an increase or decrease in material prices were also asked to provide an expected percentage change for those materials. Based on those who answered the question, respondents anticipated a price increase of 6% to 10% (median) next year for all materials. The two examples of “Other” materials are:

- All costs are increasing; insurance office supplies, labor, and vehicles
- Paint.

Table 33. Trend of Unit Cost of Construction Material for the Next Year, Price Increase

Question		Materials	Price Increase	
			Valid Responses*	Freq.
Q46	**Do you anticipate an increase in unit costs for these materials/products for the next year? Please indicate by type of material/product whether you think there will be an increase and by what percentage amount where relevant.**	Asphalt	20	71%
		Concrete	20	71%
		Cement	16	57%
		Steel	11	39%
		Other	2	7%
		No answer	56	

* Respondents were allowed to select multiple categories.

Moreover, respondents who said that they anticipate changes in the unit cost trends of various materials were given the opportunity to elaborate on their thoughts. All of these comments are presented in **Error! Not a valid bookmark self-reference.**.

Table 34. Trend of Unit Cost of Construction Material in the Next Five Years - Comments

Question		Comments
Q47	**If change indicated in Q46, Would you be able to elaborate as to why you think there will be a change or no change in unit costs for the materials/products you have selected?**	Cost of doing business.
		Difficult to forecast the world economy but it could go up or possibly down.
		Increase volume of work will drive prices higher as margins will likely increase.
		Rates to increase with labor costs.
		Tariffs
		The cost of everything is going up. Please tell agencies to adjust accordingly, and to take into account that they haven't been adjusting their estimates for too long. I'd like to make a living wage, which non-union employees (our entire office) deserve, too.

When respondents were asked whether changes in the unit cost of materials can be attributed to SB 1, 35% said that some of the cost changes can be attributed to SB 1. Meanwhile, 29% of respondents were unsure of the effects of SB 1 on the cost changes, and another 29% said that SB 1 had no effect on the anticipated cost changes. Only 6% of the respondents said that most of the cost change can be attributed to SB 1. Only those who responded with at least some understanding of SB 1 and anticipated changes to the unit cost of materials were asked this question. Moreover, due to the limited number of valid responses for each response level to this question, the full breakdown is not presented as a table.

3.6 Final Thoughts or Comments

The table below compiles all of the final thoughts and comments provided by construction contractors as part of Question 49.

Table 35. Final Thoughts or Comments

Question		Comments
Q49	**Do you have any final thoughts or comments you would like to share about how SB 1 Funding could impact the construction industry in California?**	I do not believe that SB 1 has had any negative impact on the economy, The impact is a direct result of a changing economy and aging workforce with a shortage of labor. Along with consolidation in the industry of different businesses.
		I do not think that local agencies are receiving enough funds to fix decapitated streets and roads. I think that some smaller counties are using the funds for towards their own maintenance of roads which is a waste of money. I think that critical county and city streets will see no repair during this funding period. I think that tax payers will not see the ROI for their tax dollars if this happens and will not support any future road funding bills.
		I think it's great
		I think it's great to finally see some funding. I would say that some of it is getting wasted through DBE programs but of the strict requirements. Must use even if high on bid day because your bid will get tossed if you don't meet the goals. In our experience, the DBE market generally provides a lower quality product and requires significantly more management from the GC and Owner.
		I would anticipate many shortages of qualified contractors, specifically: striping, profile grinding, rumble strip, traffic loops, and paving contractors. I would anticipate many equipment related shortages, specifically: spray pavers, shuttle buggies, bottom/end/transfer trucks, rubber asphalt plants, and other specialty paving equipment. I would anticipate many material related shortages, specifically: HMA aggregates, lime, PG oils, and HMA plant availability.
		If we could have a better way of forecasting the SB 1 projects that will be bidding in the future 12 months ahead would be very helpful.
		It does not appear Caltrans is allocating SB 1 funds to rural areas, such as D5, as much as they advertised prior to the SB 1 vote
		Petroleum/Fuel
		Please keep SB 1 in effect, we get a significant amount of work from Caltrans other public works projects. Also our roadways and infrastructure greatly need it.
		SB 1 funding is critical to keeping California’s economy moving. The lack of funding has taken a toll on our infrastructure and economy. With the lack of funding from before, Contractors have been taking care of more of their own work. SB 1 will also allow us all to get back to business.

Question	Comments
	SB 1 has had no impact in the San Diego region thus far.
	SB 1 will have little or no impact on the painting industry
	Since SB 1 was enacted, I expected a drastic increase in the amount of projects advertised for bid compared to the pace of prior years, however, the amount of projects advertised has been at a steady to somewhat slower pace than anticipated.
	Spend the money to show tax payers why there taxes are higher. Bike lanes and other transportation needs have value, but roads are where the money is needed.
	This survey is totally not relevant to our firms; activities. I find it interesting that instead of designing projects and putting them out for bid/contract, CALTRANS instead pays a lot of money to a consulting firm to determine the impacts of the agencies LACK of action. B.S.
	We're the fifth largest economy in the world. As such, our infrastructure is a complete and utter embarrassment. SB 1 is insufficient to make up for all the years of neglect. Privatization is a scam, it always was. You're paying more for less and every additional middleman is supposed to get enough of a cut to be profitable, but in reality it just squeezes the workers and employers simply don't give cost of living raises, let alone any profit sharing (of which there would be precious little anyway). Increased funding is a step in the right direction, but don't kid yourself that it's any more than one small step. Given the source of the funding is a gas tax, which is one of the big drivers of cost increases for construction, you're not getting more because you're also paying more. A property tax would have done it, a VAT or luxury tax would have done it, an extra payroll tax on anyone making above 300% of the poverty line would have done it and none of those would have increased the cost of the construction itself. Also, all those people who work in construction have to drive to work (because the infrastructure isn't there yet!), so you're taxing them more because of their profession (increasing the living costs of the union workers means the unions will be negotiating for higher pay rates, increasing the cost of infrastructure), and they don't have the option of taking public transportation. Even if they did, you think BART would let them bring their cutting and welding tools onto the trains, assuming they could even carry all of them? All of our specialists have their own tools because they're particular about their equipment and the maintenance of it so they're being taxed extra because they're highly skilled professionals in the field? Whoever designed SB 1 didn't think it through. I absolutely approve of gas taxes being higher than they are because that drives some people toward ride-shares and public transportation, but only if there's not massive housing crunches causing people to live outside the areas served by public transportation (or just living in their cars), and if there's good public transportation. Since the Bay Area has both massive housing problems and garbage public transport, it's just a punishment for anyone who can't afford to live and work near what public transport there is. My commute by car is 20-25 minutes. By public transportation it's 2 hours (according to google - I would never actually waste an extra 4 hours of my day like that). The problems of increasing costs of infrastructure are systemic and a little band-aid gas tax isn't going to fix it because it's also going to make it worse at the same time.

Question		Comments
		will improve roadways and economy
		Doesn't seem like work for SB 1 has started yet and SB 1 taxes started getting collected 3 years ago.
		tariffs have been an issue with steel

4 Summary of Findings and Conclusions

This section synthesizes the survey results to identify trends and possible effects of SB 1 on the construction industry.

4.1 Key Findings

- Most construction contractors are involved in heavy or highway construction (75%) and paving businesses (54%).
- Most respondent firms have at least some familiarity with SB 1. Specifically, 59% of respondent firms said that they are familiar with SB 1, and 30% are somewhat familiar with SB 1.
- Construction contractors pursued 78 projects (median) during July 2018 to June 2019 (mean of 147 projects), and 5 of these projects (median) were funded by SB 1 (mean of 16 projects).
- Although 46% of construction contractors noticed an increase in the total number of projects they pursued during the current fiscal year (July 2018 to June 2019) compared to the previous fiscal year (July 2017 to June 2018), 32% said that there had been no real change during that period.
    - Forty-eight percent (48%) of respondents said that this year-over-year change in the number of projects they pursued was larger than the changes observed in recent years (2013 to 2016).
- Construction contractors worked on 25 projects (median) during July 2018 to June 2019 (mean of 207 projects), and 3 of these projects (median) were funded by SB 1 (mean of 11 projects).
- Although 42% of construction contractors said that the number of projects they had completed or actively worked on during the current fiscal year (July 2018 to June 2019) had increased since the previous fiscal year (July 2017 to June 2018), 37% stated that their workloads had not really changed.
    - Fifty-three percent (53%) of respondents said that this year-over-year change in the number of projects they worked on was larger than the changes observed in recent years (2013 to 2016).
- The majority of the firms (95%) said that they would consider bidding on future SB 1 funded projects.
- Construction contractors said that the largest construction labor categories on their payroll were construction and extraction occupations, followed by management occupations. In particular, construction and extraction occupations constituted 61% to 65% of the overall payroll, while management occupations constituted about 6% to 10% of the overall payroll.
- Since 2018, construction contractors observed skill shortages mostly in construction and extraction occupations and management occupations, and 21% of the responding firms only attributed some of the skill shortages to SB 1.

- Most of the responding firms intend to expand their workforce in the next 5 years, and the median percentage increase ranged around 11% to 15%. Construction and extraction occupations are expected to experience the largest expansion, followed by occupations in management and in transportation and material moving.
- Since 2018, most firms (91%) experienced an increase in their overall wages, with a median wage increase of 4%. Furthermore, 82% of the firms expect to increase their overall wages in the next year, with the median expected increase of 4%. For the wage changes, 26% of construction contractors attributed some the changes to SB 1.
- The majority of the surveyed firms (64%) said that they had experienced shortages or delays when ordering highway or bridge construction materials since 2018. These shortages or delays did not stop the majority of the firms (76%) from bidding on projects since 2018, but did cause schedule disruptions.
    - An increased demand due to the growing number of infrastructure projects (72%) and increased demand due to the growing economy (68%) were the two reasons most selected as reasons for supply shortages or delays.
- Eighty-one percent of firms expect supply shortages or delivery delays of construction materials in the future (2019–2027). The top two materials that would have supply shortages or delivery delays were asphalt (65%) and concrete (65%).
- None of the firms had experienced a decrease in the unit cost for all construction materials since 2018. Concrete (77%) and asphalt (67%) were the top two materials that experienced an increase in unit cost since 2018, with a median increase of 6%–10%. Moreover, asphalt (71%) and concrete (71%) were also the top two materials expected to experience a unit price increase next year.
- Thirty-five percent (35%) of the firms that had at least some familiarity with SB 1 and noticed a price change attributed some of the changes in the unit costs of materials to SB 1.

4.2 Emerging Conclusions

The total number of projects pursued and projects worked on during July 2018 to June 2019 increased compared to the total number pursued and worked on during July 2017 to June 2018. A large percentage of the firms (48%) believed that this change was larger than the observed changes in recent years (2013 to 2016). The results indicate a possible correlation for the respondents between the increase in the number of highway and bridge projects in California and the implementation of SB 1.

The construction and extraction, and management occupations were the main construction labor categories on construction contractors' payrolls. Since 2018, firms have experienced skill shortages, especially in construction and extraction occupations followed by management occupations. Many respondents had commented that the "lack of skilled labor" and "competition for limited number of skilled workers" are drivers of the skill shortages and suggested that there is a shortage of skilled labor. Despite the labor shortages, the majority of firms (85%) plan to expand their workforce in the next five years. Moreover, only a small percentage (21%) of the firms who have at least some

familiarity with SB 1 attributed some of the skill shortages to SB 1, while most (41%) were uncertain about the effects of SB 1.

Since 2018, most firms (91%) experienced an increased in their overall wages, with a median increase in wages of 4%. In the next year, most firms (82%) expect an increase in their overall wages (expected median increase of 4%). However, only a small portion (26%) of construction contractors who are at least somewhat familiar with SB 1 attributed some of the wage changes to SB 1. On the contrary, most (36%) of the respondents who were at least familiar with SB 1 did not attribute any of the wage changes to SB 1.

The majority of construction contractors (64%) had experienced a shortage or delay of construction materials since 2018. The majority (72%) of the firms said that these shortages or delays might have been driven by the increased demand due to the growing number of infrastructure projects. Despite the shortages or delays, the bidding decision by most firms (76%) was not affected, but it did disrupt project schedules for nearly all of the firms (96%). As well, 42% of the respondents who were at least somewhat familiar with SB 1 attributed some of the shortages or delays to SB 1.

When respondents were asked why various products or materials are expected to be in short supply or could experience delivery delays, one respondent said that the costs of materials have gone up and that government agencies are not taking this into account in their estimate, causing delayed deliveries. In particular, this respondent stated:

> *"I did not select steel because we're not having a shortage – we're just paying more due to demand and tariffs. That means everyone's estimates will be higher in the future. Half of our bids this summer were sent to rebid because no one bid at or below the engineer's estimate and I don't see agencies taking these changes into account yet."*

The unit costs of most construction materials have increased since 2018. Asphalt (67%) and concrete (67%) were the materials for which most firms experienced unit cost increases, while steel experienced the largest increase in price (6% to 15%). Construction contractors anticipate the cost of construction materials to increase in the next year. One firm said that the "increase volume of work will drive prices higher as the margins will likely increase." Although most respondents (35%) attributed only some of the anticipated price increases to SB 1, 29% believed that SB 1 has had no effect, and another 29% were uncertain about the effects SB 1 has had on the unit costs of most construction materials.

Respondents differed in how much they attributed changes in labor skills availability and wages, and materials availability and costs, to SB 1. On one hand, the construction contractors were more likely to say that there was no effect versus some effect regarding changes to labor skills availability and wages. On the other hand, the reverse was true when questioned about changes to materials availability and costs. Overall, about a third or slightly more of respondents could not comment on whether there was an effect from SB 1 on the highlighted aspects of the industry. The comments shared by the respondents leaned toward historical challenges related to labor skills shortages, rising wages, shortages of construction materials, and rising costs. These comments indicate that the effects of SB 1 are in flux, and that contractors are not in the position to accurately quantify how SB 1 has affected construction costs over and above the existing economic and industry trends.

Although the overall survey response rate was within the industry standard at 8%, because many questions were not completed by all respondents, the results cannot be extrapolated to the overall target population of contractors. Nonetheless, HDR believes that the findings and conclusions from this survey represent the experiences and opinions of highway and bridge construction contractors in California. The results support a conclusion that SB 1's implementation since June 2017 is in a transitional phase, and that, until more SB 1 funded projects are let, the full and anticipated effects of increased demand will be not be realized.

Appendix A. Construction Contractor Questionnaire

SB 1 Impact on Construction Cost Survey

HDR Inc., an engineering consulting firm, is conducting a survey to help Caltrans understand how increased infrastructure funding from Senate Bill 1 (SB 1) will impact future highway and bridge construction costs. SB 1 invests $5.4 billion annually through 2027 to fix California's transportation system. It will address a backlog of repairs and upgrades, while ensuring a cleaner and more sustainable travel network for the future.

Your input and firsthand experience reviewing and bidding on projects funded by SB 1 will provide much needed insight on the market of construction firms, employees and materials that help Caltrans improve transportation in California.

The survey takes about 12 minutes or less, and is entirely confidential. Your survey responses will be analyzed only after all personal identifying information is removed. Survey responses will be aggregated and not be identified in the final results. Your input will be used only for this analysis.

Please complete your questionnaire by September 4, 2019. If you have any questions about this study, please don't hesitate to call May Raad at 1- 877-687-4634/email at may.raad@hdrinc.com, or you can email Mr. Joseph Dongo of Caltrans at Innovative.delivery@dot.ca.gov.

Section A: Your Firm

If you are able, please provide information about where you work to help us categorize the data.

1. Company name:
2. Job Title:
3. Email contact address:
4. City/Town:
5. Current number of employees:
6. SB/DVBE/DBE Company: Yes/No
7. If "Yes" to Q5, please indicate which one.
8. Total Company Revenue Range
    a. Under $10 million
    b. $10–$25 million
    c. $25-50 million
    d. $50-100 million
    e. $100–$250 million
    f. $250 million and over

9. Which construction categories below describe your firm? You can select more than one if applicable.
    a. Commercial
    b. Heavy/Highway
    c. Bridge Grading
    d. Underground Utility / Drainage
    e. Paving

f. Concrete Flatwork
g. Bridge Construction
h. Wall Construction
i. Traffic Signals
j. Intelligent Transportation/Advanced Traffic Management Systems
k. Municipal/Utility
l. Residential
m. Other, please describe _____

10. Are you primarily a prime contractor or a subcontractor to a lead firm? Please select one.

a. Prime
b. Subcontractor
c. Sometimes prime, sometime subcontractor

11. What types of highway/bridge construction projects does your firm bid on? Please select all that apply.

Project Work Type	Local Roads	State Bridge and Culvert	State Highway System
Maintenance/Repair			
Expansion			
New Construction			
Other, please describe			

12. What method of project delivery does your firm pursue? Please select all that apply.
a. Design-bid-Build
b. Design-Build
c. CMGC (Construction Manager/General Contractor)
d. Other, please describe _____
e. Not applicable

Section B: Your Projects

13. Are you familiar with infrastructure funding through California's Senate Bill 1 (SB 1) investments?
a. Yes
b. Somewhat familiar
c. No

14. How many projects (approximately) did your firm pursue during July 2018 to June 2019?
a. Answer _____

15. *If a, b in Q13, ASK :* How many of these projects were funded by SB 1?
b. Answer _____ (enter 0 if your firm has not worked on any SB 1 funded project that you are aware of)

16. Has the number of your total projects pursued increased or decreased compared to the projects you pursued during July 2017 to June 2018?
a. Has increased
b. Has decreased
c. No change

17. How does this change in projects compare to changes observed in recent years (i.e., 2013 to 2016)?
    a. About the same
    b. This change is larger than in recent years
    c. This change is smaller than in recent years

18. How many projects (approximately) did your firm work on during July 2018 to June 2019?
    c. Answer _____

19. *If a, b in Q13, ASK :* How many of these projects were funded by SB 1?
    d. Answer _____ (enter 0 if your firm has not worked on any SB 1 funded project that you are aware of)

20. Has the number of your total projects increased or decreased compared to the projects you had during July 2017 to June 2018?
    a. Has increased
    b. Has decreased
    c. No change

21. How does this change in projects compare to changes observed in recent years (i.e., 2013 to 2016)?
    a. About the same
    b. This change is larger than in recent years
    c. This change is smaller than in recent years

22. *If a, b in Q13, ASK:* Are there any existing let SB 1 funded projects your firm is actively pursuing and planning to submit a bid?
    a. Yes
    b. No
    c. Don't know

23. If "*Answer = Yes in Q22*", ASK: Approximately, how many of such projects is your firm considering?
    a. Answer: _____

24. *If a, b in Q13, ASK:* Would your firm consider bidding on future SB 1 funded projects once they are let?
    a. Yes
    b. No
    c. Don't know

25. *If "Answer = No in Q24*, ASK: Would you be able to explain why your firm would not want to bid on future SB 1 funded projects? **[Open End]**

Section C: Your Workforce

26. Please provide a breakdown of the types of **construction labor categories** your firm has on payroll using percentages. If you don't have any in a category, please enter 0.

Labor Category	%
a. Architecture and Engineering Occupations (e.g., civil, electrical engineers/technicians, etc.)	_____
b. Business and Financial Operations Occupations (e.g., cost estimators)	_____
c. Construction and Extraction Occupations (e.g., construction laborers, Cement Masons and Concrete Finishers, Paving, Surfacing, and Tamping Equipment Operators, etc.)	_____
d. Installation, Maintenance, and Repair Occupations (e.g., industrial machinery mechanics, electrical power line installers, telecommunications installers, etc.)	_____
e. Management Occupations (e.g., construction managers)	_____
f. Production Occupations (e.g., welders, solderers, tool setters, etc.)	____
g. Transportation and Material Moving Occupations (e.g., truck and tractor operators, drivers, freight/stock laborers, etc.)	_____
h. Other, please describe, _____	____
Total	100%

27. Please indicate if you have observed skill shortages since 2018 by construction labor categories. Please provide examples of specific jobs where your firm had difficulty filling positions.

Labor Category	Shortage	Examples
a. Architecture and Engineering Occupations (e.g., civil, electrical engineers/technicians, etc.)	yes/no	_____
b. Business and Financial Operations Occupations (e.g., cost estimators)	yes/no	_____
c. Construction and Extraction Occupations (e.g., construction laborers, Cement Masons and Concrete Finishers, Paving, Surfacing, and Tamping Equipment Operators, etc.)	yes/no	_____
d. Installation, Maintenance, and Repair Occupations (e.g., industrial machinery mechanics, electrical power line installers, telecommunications installers, etc.)	yes/no	_____
e. Management Occupations (e.g., construction managers)	yes/no	_____
f. Production Occupations (e.g., welders, solderers, tool setters, etc.)	yes/no	____
g. Transportation and Material Moving Occupations (e.g., truck and tractor operators, drivers, freight/stock laborers, etc.)	yes/no	_____
Other, please describe, _____	yes/no	____

28. For the labor categories where you have indicated shortages, would you able to list the most important factors causing the labor shortages? Examples could be not enough skilled labor, competition for limited numbers of skilled workers, lack of journey level skillset, etc. **[Open End]**

29. *If a, b in Q13, ASK:* For the labor shortages you've indicated, how much of the shortages can be attributed to SB 1?
    a. None
    b. Some
    c. Most
    d. All
    e. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**

30. Do you intend to expand your firm's workforce in the next **five years**, and if so, by how much? Please select one.
    a. Yes, Increase of _____ percent
    b. No, Decrease of _____ percent
    c. No, No Change
    d. Don't know

31. Within the overall construction labor workforce, what labor category do you expect will experience more expansion and by what percentage of growth in the workforce over the **next five years**? Please select all that apply.

Labor Category	% Growth
a. Architecture and Engineering Occupations (e.g., civil, electrical engineers/technicians, etc.)	_____
b. Business and Financial Operations Occupations (e.g., cost estimators)	_____
c. Construction and Extraction Occupations (e.g., construction laborers, Cement Masons and Concrete Finishers, Paving, Surfacing, and Tamping Equipment Operators, etc.)	_____
d. Installation, Maintenance, and Repair Occupations (e.g., industrial machinery mechanics, electrical power line installers, telecommunications installers, etc.)	_____
e. Management Occupations (e.g., construction managers)	_____
f. Production Occupations (e.g., welders, solderers, tool setters, etc.)	_____
g. Transportation and Material Moving Occupations (e.g., truck and tractor operators, drivers, freight/stock laborers, etc.)	_____
h. Other, please describe, _____	_____
i. Don't know	

32. What was the percent change in your firm's overall wages since 2018? Please select one.
    a. No Change
    b. Increase of _____ percent
    c. Decrease of _____ percent

33. Do you think overall wages will change next year, and if so by what percentage? Please select one.
    a. No Change
    b. Increase of _____ percent
    c. Decrease of _____ percent
    d. Don't know

34. *If a, b in Q13, ASK:* For the wage changes you've indicated, how much of the changes can be attributed to SB 1?
    a. None
    b. Some
    c. Most
    d. All
    e. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**

Section D: Supply of Materials/Products

35. Has your firm experienced shortages or delays when ordering highway/bridge construction materials such as asphalt, cement, ready-mix concrete, steel or components such as lighting or intelligent transportation systems since 2018?
    a. Yes
    b. No *(coding instructions: Go To Q45)*

36. Are you able to provide examples of materials/products which were in short supply or delayed at the time your firm planned or needed to have the material/product available since 2018? Please provide as many examples with estimate of quantity if you can.

    a. Asphalt _____
    b. Cement _____
    c. Concrete _____
    d. Steel _____
    e. Other1, please describe and indicate quantity _____
    f. Other2, please describe and indicate quantity _____
    g. Other3, please describe and indicate quantity _____

37. Did this shortage/delay cause your firm not to bid on projects since 2018?
    a. Yes
    b. No

38. Did this shortage/delay cause a schedule disruption for at least one of your firm's existing projects since 2018?
    a. Yes
    b. No

39. What do you think would be the reasons for this supply shortage/delay? Please select all that apply.
    a. Increased demand due to growing economy
    b. Increased demand due to growing number of infrastructure projects
    c. Producer/supplier changing business operations
    d. Difficulties sourcing materials
    e. Tariffs
    f. Truck driver shortages
    g. Other, please describe
    h. Don't know

40. Do you anticipate short supply or delivery delays of these materials/products in the future (2019-2027)?
    a. Yes
    b. No
    c. Don't know

41. *If "Yes" in Q41, ASK:* Are you able to indicate which of the materials/products you think will be in short supply or have delayed deliveries? Please select all that apply.
    a. Asphalt ___
    b. Cement ___
    c. Concrete ___
    d. Steel ___
    e. Other1, please describe ___
    f. Other2, please describe ___
    g. Other3, please describe ___
    h. Don't know

42. *If "Yes" in Q41, ASK:* Why do you think the materials/products you indicated would be in short supply or could have delayed deliveries? Please feel free to elaborate. For example, production capacity is not able to meet the demand. **[Open End]**

43. *If a, b in Q13 and If "Yes" in Q41, ASK:* For the materials/products you think will be in short supply in the future, how much of the shortages/delays can be attributed to SB 1?
    a. None
    b. Some
    c. Most
    d. All
    e. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**

Section E: Costs of Materials/Products

44. Have you observed a trend in unit costs for these materials/products since 2018? Please indicate by type of material/product whether there has been no change, an increase or a decrease and by what percentage amount where relevant.

Material	No Change	%Increase	%Decrease
a. Asphalt	___	_____	_____
b. Cement	___	_____	_____
c. Concrete	___	_____	_____
d. Steel	___	_____	_____
e. Other1, please describe	___	_____	_____

f. Other2, please describe	___	_____	_____
g. Other3, please describe	___	_____	_____

45. Would you be able to elaborate as to why you have seen a change or no change in unit costs since 2018 for the materials/products you have selected? **[Open End]**

46. Do you anticipate a trend in unit costs for these materials/products for the next year? Please indicate by type of material/product whether you think there will be no change, an increase or a decrease and by what percentage amount where relevant.

Material	No Change	%Increase	%Decrease
a. Asphalt	___	_____	_____
b. Cement	___	_____	_____
c. Concrete	___	_____	_____
d. Steel	___	_____	_____
e. Other1, please describe	___	_____	_____
f. Other2, please describe	___	_____	_____
g. Other3, please describe	___	_____	_____
h. Don't know			

47. *If change indicated in Q46, ASK*: Would you be able to elaborate as to why you think there will be a change or no change in unit costs for the materials/products you have selected? **[Open End]**

48. *If a, b in Q13, and change indicated in Q46, ASK:* For the changes in unit costs you've indicated, how much of the changes can be attributed to SB 1?
    a. None
    b. Some
    c. Most
    d. All
    e. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**

49. Do you have any final thoughts or comments you would like to share about how SB 1 Funding could impact the construction industry in California **[Open End]**

That completes our Survey. Thank you for your time.

Appendix B. Q27 – Specific Examples of Jobs with Shortages

4.2.2 Specific Examples of Jobs with Shortages since 2018

	Question	Responses	Valid Responses
Q27 Part B	Please indicate if you have observed skill shortages since 2018 by construction labor categories. Please provide examples of specific Jobs where your firm had difficulty filling positions.	Architecture and Engineering Occupations (e.g., civil, electrical engineers/technicians, etc.)	BIM Modelers
			civil engineers
			engineers
			field engineers
			Low unemployment has made it difficult to find skilled staff
			Qualified SWPPP Developers, Qualified SWPPP Practitioners
			we have a need from BIM modelers. currently out sourcing
		Business and Financial Operations Occupations (e.g., cost estimators)	Accounting
			CFO
			Estimators
			have hired 2 over the past year. 1 did retire but that was recently
		Construction and Extraction Occupations (e.g., construction laborers, Cement Masons and Concrete Finishers, Paving, Surfacing, and Tamping Equipment Operators, etc.)	All trades are at short supply. All of our craft workers are working daily. additional resources are difficult to locate which limits the quantity of work that can be attained at any one time.
			All trades. Union halls are tapped. The few that remain on their list typically aren't qualified.
			always need more to catch up with work.
			cement masons, concrete finishers, paving
			Construction Laborers, Equipment Operators
			Crane and equipment operators
			Equipment operators
			Forestry inspector, tree fellers
			lacking skilled applicants
			No issues we are signatory to 5 unions
			Operators, laborers, teamsters..... Paving personnel especially!
			Qualified Equipment Operators
			Qualified Laborers and Operators
			Skilled construction workers
			Skilled Laborer with knowledge.

Question	Responses	Valid Responses
		Traffic Control
		We advertise for laborers, masons, asphalt paving with very little success
		We are signatory to the unions and they don't have qualified help available to fill the seats.
	Installation, Maintenance, and Repair Occupations (e.g., industrial machinery mechanics, electrical power line installers, telecommunications installers, etc.)	Electricians and Data Techs
		It is difficult if not impossible to find qualified help.
	Management Occupations (e.g., construction managers)	Good/Experienced Estimators and PM's
		have hired 2 in the past year
		Project Managers
		Project Managers and Field Supers
		project managers, construction quality control
		Qualified project managers are in short supply. Strong recruiting through colleges has increased incoming Project Engineers and are trained in-house.
		Qualified SWPPP Developers and Project Managers
		We have had an ad for the past four years trying to find a qualified Project Manager and have not had any success. We are having to develop and train our Managers.
	Production Occupations (e.g., welders, solderers, tool setters, etc.)	Welders
	Transportation and Material Moving Occupations (e.g., truck and tractor operators, drivers, freight/stock laborers, etc.)	always need more drives to deliver/pick up materials and equipment
		Class A drivers
		equipment operators
		Laborers
		lacking skilled drives
		Material Haulers
		Material truck shortage across State
		Material trucking has been in very short supply. At ties work has been postponed due to availability. Increased costs have been incurred due to having to use alternate trucking means.

Question	Responses	Valid Responses
		Qualified Drivers
		truck drivers and concrete workers, labor and general
		truckers -- especially with ever increasing CARB regulations
		We advertise for truck drivers and equipment operators with very little success
		We have 16 trucks and have not been able to fill all of the seats in each of those trucks for the past two years.
	Other	No difficulties filling needed positions.
		Skilled Labor for asphalt and aggregate plants, loader and equipment operators.

Appendix B

Materials Supplier and Producer Survey Methodology and Report

Executive Summary

The objective of the survey was to collect first-hand knowledge of demand and supply conditions from the perspective of materials producers and suppliers. The survey collected information regarding how familiar materials suppliers and producers were with SB 1, and how SB 1 has affected the number of projects to which they have supplied materials or products. Furthermore, the survey gathered information regarding the future availability of construction materials, the overall change in material unit prices since SB 1 was implemented, and how much these changes could be attributed to SB 1. The survey targeted materials suppliers and producers in California.

HDR administered the SB 1 Impact on Construction Cost Survey for material suppliers and producers online starting on August 21, 2019 and ending on September 30, 2019. This survey was sent to 529 materials suppliers or producers in California. However, 120 of those emails were no longer valid, leaving 409 firms that received invitations. The overall response rate for the materials suppliers' or producers' survey was 8.1%.

Key Findings

- The top two materials manufactured or supplied by respondents were asphalt (72%) and aggregates (52%).
- A majority (73%) of the materials producers or suppliers were familiar with SB 1.
- From July 2018 to June 2019, respondents had supplied materials to an average of 329 projects (with a median of 75 projects), while an average of 28 projects were funded by SB 1 (with a median of 4 projects).
- A large share of respondents (46%) experienced no real increase in the number of projects for which they supplied materials, when compared to the number of supplied projects during July 2017 to June 2018. Instead, almost 32% had noticed a decrease.
- During July 2018 to June 2019, most firms (just over 90%) had been able to provide customers with the materials or products in the quantity requested.
- About 79% of respondents had an optimistic outlook for materials and product availability in the next 5 years. Moreover, 74% of respondents expected a steady increase in the demand of construction materials or products over the next 5 years.
- Since 2018, the majority (71%) of the responding firms experienced an increase in their overall unit price, where the median price increase was about 5%. Nearly 56% said that this change in overall unit prices was on par with what they had observed in recent years.
- Half (50%) of respondents attributed increases in unit prices for their materials or products to increased demand due to a growing economy. Other notable reasons offered were an increased demand due to the growing number of infrastructure projects (43%) and truck driver shortages (43%). Forty percent of respondents attributed some of the cost changes to SB 1.

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Acronyms and Abbreviations

Caltrans	California Department of Transportation
DBE	Disadvantaged Business Enterprise
DVBE	Disabled Veteran Business Enterprise
Freq.	frequency
NA	not applicable
NAICS	North American Industry Classification System
Q	question
SB	Senate Bill
SB	Small Business (in Table 3)

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1 Introduction

HDR conducted multiple surveys in California on behalf of the California Department of Transportation (Caltrans). Caltrans is interested in understanding how increasing infrastructure funding from Senate Bill 1 (SB 1) will affect future highway and bridge construction costs. The goal of SB 1 is to address a backlog of repairs and upgrades to the transportation system while ensuring a cleaner and more sustainable travel network for the future. The funding program will do so through investing $5.4 billion annually to repair California's transportation system.

Although the overall study conducted by HDR seeks to understand the effects of SB 1, one of the surveys was conducted to understand the effects that SB 1 has on demand and supply conditions for materials suppliers and producers through their first-hand experience and knowledge. This report presents the findings of that survey (the SB 1 Impact on Construction Cost Survey for materials suppliers and producers), focusing on the effects of SB 1 as observed by materials suppliers and producers in California.

The survey collected perceptions from materials suppliers and producers on the year-over-year changes in the number of construction projects to which they have supplied materials or products since 2017, and asked whether these changes were different than in years just prior to SB 1 being implemented. The survey asked whether suppliers and producers have experienced material shortages and possible reasons for the shortages. Reasons cited could be, but not limited to: growing economy, higher number of projects, difficulties sourcing materials, or truck driver shortages.

The survey also explored changes in unit prices for the materials they supply or produce. Most importantly, the survey asked through means of open-ended questions the respondents' outlook for materials availability and demand over the next five years. The responses provided by the participating materials suppliers and producers, when aggregated, weave a picture of the current state of the highway and bridge construction industry through their perspective as of mid-2019.

The remainder of this document is divided into the following sections:

- *Section 2 – Survey Methodology* provides an overview of the survey and how the data were collected.
- *Section 0 – The data* from the 33 respondents to the survey are sufficient to provide trending insights on the industry and how it has been affected by SB 1 to date. However, it might be premature to extrapolate survey results to all 409 firms invited to complete the survey. Note that the approximate 8.1% response rate (33/409) from this survey is in line with the typical response rate for online surveys, which ranges from 5% to 30%.
- Survey Results identifies the number of valid responses received for each question.
- *Section 4 – Summary of Findings and Conclusions* summarizes relevant findings and conclusions drawn from the survey results.

2 Survey Methodology

The objective of the survey was to collect first-hand knowledge of demand and supply conditions from the perspective of material producers and suppliers. The survey helped HDR understand whether there is sufficient aggregate availability for asphalt concrete, cement concrete, aggregate base, and aggregate sub-base for the work anticipated over the next 10 years. The survey collected information regarding how familiar materials suppliers and producers were with SB 1, and how SB 1 has affected the number of projects for which they have supplied materials or products.

Furthermore, the survey gathered information regarding the future availability of construction materials, the overall change in materials' unit prices since SB 1 was implemented, and how much of these changes could be attributed to SB 1. The survey targeted materials suppliers and producers in California.

2.1 Sampling Frame

In order to invite targeted materials suppliers and producers to complete the survey, HDR prepared a list of these businesses' names, phone numbers, and email addresses in California using data purchased on August 6, 2019, from ReferenceUSA.[1] The list of purchased contact information of materials suppliers and producers was composed of businesses with the NAICS[2] codes presented in Table 1.

Table 1. NAICS Codes

Description	NAICS Code
Construction–Sand & Gravel	21232101
Sand & Gravel–Manufacturers	21232105
Quarries	21232102
Gravel Consultants	21232104
Asphalt & Asphalt Products–Manufacturers	32412101
Steel Mills (Manufacturers)	33111007
Steel Processing (Manufacturers)	33111008
Steel Works/Blast Furnaces/Rolling Mills	33111009
Aggregates–construction Materials (Wholesale)	42332001
Concrete Aggregates (Wholesale)	42332014
Asphalt Aggregates (Wholesale)	42332002
Asphalt Products–Wholesale	42332003
Cement–Portland–Wholesale	42332010
Concrete Curbing (Wholesale)	42332052
Concrete Products (Wholesale)	42332015
Concrete Products (Wholesale)	42332017
Sand & Gravel (Wholesale)	42332036
Excavating Equipment (Wholesale)	42381004

[1] ReferenceUSA, Dallas, Texas, USA, main website: http://resource.referenceusa.com/.

[2] The North American Industry Classification System (NAICS) is used by the United States, Canada, and Mexico to classify businesses by industry. Website: https://www.census.gov/smallbusiness/html/naics.html.

Description	NAICS Code
Road Building Equipment (Wholesale)	42381005
Asphalt Machinery (Wholesale)	42381016
Paving Equipment (Wholesale)	42381007
Bridge Materials	53241201
Concrete Equipment & Supplies–Renting	53241203
Excavating Equipment–Renting & Leasing	53241204
Excavating Equipment–Renting & Leasing	53241206

2.2 Questionnaire Development

The objective of the survey questionnaire was to identify how aggregate availability will affect the pricing of asphalt concrete, cement concrete, aggregate base, and aggregate sub-base on Caltrans projects. The questionnaire asked respondents to estimate the number of projects for which they supplied materials during July 2018 to June 2019, and how many of these projects were funded by SB 1.

In order for HDR to better understand the current availability of construction materials, the questionnaire asked respondents whether their firms had been able to provide their customers with the materials in the quantity requested. The questionnaire also asked the respondents for their opinions regarding the outlook of construction materials availability and demand over the next five years. Lastly, the questionnaire asked respondents whether they experienced a change in overall unit prices since 2018, and how much of this change (if any) could be attributed to SB 1.

The survey of materials suppliers and producers in California consists of five components:

- *Section A – Your Firm*: Materials supplier and producer firm details
- *Section B – Your Customers*: Details regarding the number of projects supplied materials during July 2018 to June 2019 and how this compared to the number of projects during July 2017 to June 2018 and recent years (2013–2016)
- *Section C – Price Trends*: Change in overall material or product unit prices since 2018.

The questionnaire used for the survey is included in Error! Reference source not found. of this report.

2.3 Survey Administration

HDR administered the SB 1 Impact on Construction Cost Survey for materials suppliers and producers online through SurveyMonkey[3] starting on August 21, 2019 and ending on September 30, 2019. This survey was sent to 529 materials suppliers or producers in California. However, 120 of those emails were no longer valid, leaving 409 firms that received the online survey invitations. These invitations included phone numbers and emails in case the potential respondents had any questions or concerns about the study.

[3] SurveyMonkey Inc., San Mateo, California, USA, main website: http://www.surveymonkey.com.

Additional reminders were sent out to complete the survey on August 16, 2019. Firms that had not completed the survey by August 29, 2019, were contacted by phone as a reminder and as an opportunity to provide them additional support if needed. All the online responses were automatically saved in a database format as an SPSS[4] (Statistical Package for Social Sciences) file with fixed record layouts.

As shown in Table 2, 33 respondents started to take the survey, but only 64% completed the survey. Although the remaining 36% did not complete all the questions in the survey, the completed questions contributed to the overall survey analysis.

Table 2. Number of Completed and Partially Completed Surveys

Survey Type	Number	Percentage
Completed surveys	21	63.6%
Partially completed surveys	12	36.4%
Total surveys	**33**	**100.0%**

The data from the 33 respondents to the survey are sufficient to provide trending insights on the industry and how it has been affected by SB 1 to date. However, it might be premature to extrapolate survey results to all 409 firms invited to complete the survey. Note that the approximate 8.1% response rate (33/409) from this survey is in line with the typical response rate for online surveys, which ranges from 5% to 30%.[5]

[4] IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

[5] What's a Typical Survey Response Rate?, Aaron Jue, FocusVision, April 24, 2019. Link: https://www.focusvision.com/blog/whats-a-typical-survey-response-rate/.

3 Survey Results

This section summarizes the responses to the survey by materials suppliers and producers with the results presented by each component of the survey (i.e., Section A to Section C). Each table lists the number of valid survey responses received for a question as well as the valid percent frequency for each response. The valid percent frequency is based on the number of respondents who answered the question. If eligible respondents skipped a question, the count is recorded in the tables below as "No answer" for information purposes. Finally, if less than five respondents selected a response category for a given question, the question's tabulation is either collapsed or entirely suppressed to protect respondents' confidentiality, and only percentages are shown.

3.1 Section A – Your Firm

The responses for Section A of the questionnaire are presented in Table 3. The results show that the responding firms ranged in size significantly. The smallest firm reported having 6 employees, and the largest reported having 10,000 employees (Q5). The median number of employees was 56 (Q5). Furthermore, 24% of the respondents had a small business number (Q6), and 38% of the respondents had a total company revenue of $100 million or more (Q8).

The results also show that 72% of respondents were in involved in the production or distribution of asphalt, while 52% of respondents were in the aggregates business (Q9). In response to Question 9, respondents provided the following other materials and products that their firms manufacture:

- Roadway signs and signing components
- Paints and coatings
- Crack sealant and mastics
- Distributor of heavy road building equipment
- Equipment dealership
- Geotextiles – paving fabric
- Inert processing facility
- Landscape material
- Metal distribution (rather than manufacturing)
- Asphalt binder
- Asphalt emulsions

Table 3. Materials Supplier and Producer Firm Details (1/2)

Question		Responses	Valid Responses	Freq.
Q5	**Current number of employees**	N	28	NA
		No answer	5	NA
		Mean	1,174	NA
		Median	56	NA

		Minimum	6	NA
		Maximum	10,000	NA
Q6	Do you have a SB/DVBE/DBE number?	Yes	8	24.2%
		No	25	75.8%
		No answer	0	NA
Q7	If "Yes" to Q6, please indicate which one.	SB	8	100.0%
		DVBE	0	0.0%
		DBE	0	0.0%
		No answer	0	NA
Q8	Total company revenue range	Under $5 million	8	25.0%
		$5–$10 million	5	15.6%
		$10–$50 million	7	21.9%
		$50–$100 million	0	0
		$100 million and over	12	37.5%
		No answer	1	NA
Q9	Which category of material below closely reflects what your firm manufactures? You may select more than one if applicable.	Asphalt	18	72.0%
		Concrete	3	12.0%
		Aggregates	13	52.0%
		Other	13	36.0%
		No answer	6	NA

Table 4 shows the number of facilities that respondents had in California and outside the state. In California, the responses listed an average of 7 separate facilities and a maximum 50 facilities (Q10). Outside California, the respondents listed an average of 22 facilities and a maximum of 309 facilities (Q10).

Table 4. Materials Supplier and Producer Firm Details (2/2)

Question			Responses	Valid Responses
Q10	How many other separate facilities does your firm have?	**In California:**	N	27
			No answer	6
			Mean	7
			Median	2
			Minimum	0
			Maximum	50
		Outside California:	N	20
			No answer	13
			Mean	22
			Median	2
			Minimum	0
			Maximum	309

3.2 Section B – Your Customers

Section B of the questionnaire established whether the respondents were familiar with SB 1, since subsequent questions and sections required at least some in order to provide responses. A large majority of respondents (90%) were aware of SB 1. The remainder of Section B asked about the number of projects for which respondents supplied materials or products during July 2018 to June 2019.

Table 5 shows that respondents supplied materials for an average of 329 projects during July 2018 to June 2019, with a median of 75 projects.

Table 5. Number of Projects Firms Supplied Materials during July 2018 to June 2019

Question		Responses	Valid Responses
Q12	**For how many projects (approximately) did your firm supply materials or products to construction firms during July 2018 to June 2019?**	N	20
		No answer	13
		Mean	329
		Median	75
		Maximum	2,000
		Minimum	2

Question 13 (Table 6) asked respondents about the number of projects that were funded by SB 1 for which they supplied materials. The number of projects funded by SB 1 ranged from 0 to 161, with a median of 4 projects.

Table 6. Number of Projects Firms Supplied Materials during July 2018 to June 2019 Attributed to SB 1

Question		Responses	Valid Responses
Q13	**How many of those projects were funded by SB 1? (Enter 0 if you have not bid on any SB 1 project that you are aware of.)**	N	19
		No answer	14
		Mean	28
		Median	4
		Maximum	161
		Minimum	0

Question 14 asked respondents whether their total number of projects increased or decreased compared to the period from July 2017 to June 2018. As shown in Table 7, 23% of respondents said that the total number of projects had increased, while 46% experienced no change in the total number of projects.

Table 7. Change of Projects during July 2017 to June 2018

Question		Responses	Valid Responses	Freq.
Q14	**Has the number of your total projects increased or decreased compared to the projects you had during July 2017 to June 2018?**	No change	10	45.5%
		Has decreased	7	31.8%
		Has increased	5	22.7%
		No answer	11	NA

Question 15 asked respondents how the changes in projects, as stated in response to the previous question, compared to changes observed in recent years (2013 to 2016). As shown in Table 8, about 52% of the materials suppliers or producers said that the change was about the same or smaller than in recent years, while 48% said that this change was larger than in recent years.

Table 8. Change in Projects Compared to Changes in Recent Years

Question		Responses	Valid Responses	Freq.
Q15	**How does this change in project numbers compare to changes observed in recent years (i.e., 2013 to 2016)?**	About the same or smaller than in recent years	11	52.4%
		This change is larger than in recent years	10	47.6%
		No answer	12	NA

Question 16 asked whether respondents had been able to provide their customers with the materials or products in the quantity requested during July 2018 to June 2019, and just over 90% said they had been able to do so.

Questions 17 to 20 were not analyzed due to insufficient data.

Table 9 presents the responses to Question 21, which asked respondents their outlook for construction materials availability over the next five years. The majority of respondents (79%) who offered opinions suggested a good or average outlook for materials or products. One respondent said that, in the next five years, there will be strong availability of construction materials. Another respondent said that resources are dwindling due to excessive permitting requirements. Interestingly, one respondent had a specific comment regarding asphalt:

> *"Superpave asphalt[6] and its enforcement to a one size fits all standard statewide will limit commercially available materials. If municipality work increases, more suppliers will focus on those projects rather than working for Caltrans, unless Caltrans begins to partner more effectively with industry."*

[6] Superpave is a performance-based suite of test procedures for selecting materials and designing asphalt mixes. The Caltrans regulation is at http://ppmoe.dot.ca.gov/hq/esc/oe/construction_contract_standards/std_specs/2018_StdSpecs/2018_StdSpecs.pdf.

Table 9. Outlook for Construction Materials over the Next Five Years

Question		Comment
Q21	**In your opinion, what is the outlook for your material's/product's availability over the next 5 years?**	Good.
		Average.
		Depends upon which market and what CT decides to let each year. Expect to cover market needs at this time as unused capacity is still high.
		Good.
		Good.
		Good because we have a pretty good sense/idea, with talking to our customers and their needs it allows us to make a safe judgment on what to stock from our manufacture to be able to deliver to the customer when the time is right.
		Gradual increase over the next five years.
		No future problems foreseen. Inventory will be available.
		No supply issues forecast.
		Plentiful.
		Resources are dwindling due to excessive permitting requirements.
		Short.
		Shortage of AB, Crushed rock and bedding sand.
		Strong availability.
		Superpave asphalt and its enforcement to a one size fits all standard statewide will limit commercially available materials. If municipality work increases, more suppliers will focus on those projects rather than working for Caltrans, unless Caltrans begins to partner more effectively with industry.
		Supply lines have returned as long as Govt' does not intervene.
		The availability is okay.
		We have not seen an increase in work. In fact the outlook does not look very good for next year so far. Thus availability will be high.
		We should have plenty of materials available.

Although the previous table lists respondents' comments on the availability of materials and products over the next five years, Table 10 presents the responses on the demand over the same period. Almost 74% of respondents said that they expected a steady increase in demand over the next five years, with one respondent having a positive outlook that stems from "many funded projects in the queue to get started in the next 2 years." On the other hand, a few respondents said that they expected their demand to either remain flat or decrease slightly.

Table 10. Outlook for Materials' Demand over the Next Five Years

Question		Comment
Q22	**In your opinion, what is the outlook for your material's/product's demand over the next 5 years?**	A steady increase of a couple percent.
		Again, we are not seeing an increase in projects from SB 1 on our current look ahead.
		Below average.
		Demand will increase.
		Flat.
		Good.
		Good.
		Great as we have many funded projects in the queue to get started in the next 2 years.
		Increase.
		Material supply through central California will remain plentiful.
		Positive.
		Steadily increasing.
		Steady.
		Steady for the first few comparing to the last two then a slight decrease.
		Steady increase over the next five years.
		Strong demand.
		Strong through mid-2020 then slowing some on the private side but hopefully an up-tick in public works.
		The increasing costs will squeeze us out.
		We are near the top of the cycle. It will average staying flat.

3.3 Section C – Price Trends

Section C of the questionnaire asked respondents for detailed information regarding the change in unit prices of materials or products since 2018 and prior to 2017, and how much of the change could be attributed to SB 1.

Table 11 shows that 71% of the respondents experienced a change in their overall unit prices since 2018, with a median price increase of about 5%. Meanwhile, 29% of respondents experienced either a decrease or no change in their overall unit prices since 2018.

Table 11. Change in Overall Unit Prices since 2018

Question		Responses	Valid Responses	Freq.
Q23	**Did you experience a change in your overall materials' or products' unit prices since 2018? Please select one.**	Increase of _____percent	15	71.4%
		No change or decreased	6	28.6%
		No answer	12	NA

Respondents who stated a unit price change were asked how the recent price change compared to price changes between 2013 and 2016. Based on the results presented in Table 12, 56% said that the changes observed since 2018 were more or less what they have observed in recent years (2013–2016).

Table 12. Change in Overall Unit Price Compared to Changes in Recent Years

Question		Responses	Valid Responses	Freq.
Q24	**If *b* or *c* selected in Q23, has this increase or decrease been more or less what you have observed in recent years (i.e., 2013–2016)?**	Yes	10	55.6%
		No	8	44.4%
		No answer	15	NA

Table 13 shows that 71% of respondents believed that their unit prices will increase in the next year, with a median price increase of 5%.

Table 13. Overall Unit Prices Change in the Next Year

Question		Responses	Valid Responses	Freq.
Q25	**Do you think your overall unit prices will change next year?**	Increase of _____percent	15	71.4%
		No change, decrease, or don't know	6	28.6%
		No answer	12	NA

Table 14 presents the responses to Question 26 – Part A, which asked respondents to provide factors driving the changes in their unit prices. Half of the respondents attributed increased prices to increased demand due to growing economy. Other notable reasons were a growing number of infrastructure projects and truck driver shortages (each at 43%).

Table 14. Reasons for Change in Unit Prices

Question		Responses	Valid Responses	Freq.
Q26 Part A	**What do you think would be reasons for a change in your unit prices? Please select all that apply.**	Increased demand due to growing economy	7	50.0%
		Increased demand due to growing number of infrastructure projects	6	42.9%
		Truck driver shortages	6	42.9%
		Difficulties sourcing materials	5	35.7%
		Other	9	35.7%
		No answer	19	NA

In addition to the responses presented in the table above, respondents were given the opportunity to elaborate on their opinions (see Table 15). A number of respondents said that tight regulations in California are causing the unit price changes. One respondent identified a problem with Caltrans' Superpave hot mix requirements.

Table 15. Reasons for Change in Unit Prices – Comments

Question		Comment
Q26 Part B	**If you would like, please feel free to elaborate on your response.**	Air regulations for trucks and construction equipment requires buying new equipment. Groundwater regulation may hamper production. Endangered species mitigation cost rising…
		Government costs
		Having problem with Caltrans super pave hot mix requirements
		Increases in labor cost, insurances (auto, medical, general liability, WORKERS COMP. Workers comp should fix how they charge for the over time required to meet deadlines. (not enough skilled labor) because we have to pay time & 1/2 and their fees go
		Larger scale projects which require more technical mix designs, more time and effort invested to meet tight specifications.
		Steel Tariffs have made a pretty big increase already. The 3% increase it what our manufactures commonly do yearly
		We have experienced large increases due to CARB requirements, energy, trucking costs, oil increases, insurances, labor, and Caltrans asphalt material deduction penalties.
		Cost increases in labor, materials, permitting and environmental offsets.
		cost of raw materials
		crude costs
		Environmental Regulation.
		material prices and wages

Table 16 shows respondents' perspectives on how changes in the unit price of materials or products could be attributed to SB 1. Only respondents who expressed at least some understanding of SB 1 were presented this question. Of those who answered, 40% attributed some of the cost changes to SB 1, while 60% did not believe SB 1 had any effects or were unsure of the effects. In addition, respondents who said that the unit price changes could be attributed to SB 1 were given the opportunity to elaborate on their thoughts. Their comments are presented in Table 17.

Table 16. Changes in Unit Price Attributed to SB 1

Question		Responses	Valid Responses	Freq.
Q27 Part A	**If *a* or *b* in Q11, for the unit price changes you've indicated, how much of the changes can be attributed to SB 1?**	None or not sure	9	60.0%
		Some	6	40.0%
		No answer	13	NA

Table 17. Changes in Unit Price Attributed to SB 1 – Comments

Question		Comments
Q27 Part B	**If you would like, please feel free to elaborate on your response.**	Do not see much participation in SB 1 projects.
		Fuel tax.
		SB 1 Impact is truly unknown at this time.
		SB 1 is not the driving force, however supply is dwindling and demand remains strong.

3.4 Final Thoughts or Comments

The table below compiles (verbatim) all of the final thoughts and comments provided by material suppliers or producers who participated in the survey.

Table 18. Final Thoughts or Comments

Question		Comments
Q28	**Do you have any final thoughts or comments you would like to share about how SB 1 funding could impact the construction industry in California?**	Fix workers comp Claims being PAID without employers having say. when you add to what employees get paid for filling a claim when we have video confirming there should be no claim (But employee Is always correct!) then we as employers get from the state when employees go file for un employment because we had to fire due to them not showing up to work the state tells us the employer "You can't fire them because they don't show up to work!" when the documentation, the counseling, the 10 warning given don't count… this state is simply TO LIBERAL.
		2018–2019 were transitional years. We expected 2020 and beyond to be fully funded and amount and size of projects to increase.
		Communication to industry with regards to project planning concepts is critical for industry to be prepared well in advance of projects.
		Find a way to fund than just fuel.
		Good infrastructure is required for a successful economy. SB 1 keeps California moving and improves the quality of life for all.
		I believe ultimately it will spur demand.
		I feel that SB 1 is (has) increasing Caltrans work. I further feel that local work has not changed in volume. Cities and county work has remained flat. Increased monies are being diverted to other programs. Our total volume is actually down from one year ago.
		It's going to be a great thing creating jobs and increasing sales to meet the demands of the needs from the contractors. The negative impact is the lack of qualified/knowledgeable workforce to complete the jobs with excellent quality.
		None.
		The slow start of SB 1 funds hitting the contractor level will drive capacity issues with trucking, labor, and materials in the future when funds hit the market all at once. A steady stream of projects and $ will allow contractors and material suppliers to better plan for the increased activity and the state to get a lower price and more stable bidding environment. Pick up the pace CT!
		We are not seeing an increase in projects in our area (Lassen, Modoc, and Plumas Counties). In fact current look ahead appears to be fairly bleak.
		Where is the funding? We have seen almost no SB 1 funding for project here in Caltrans district 1 for both state and local projects.

4 Summary of Findings and Conclusions

This section summarizes the survey results to identify trends and possible effects of SB 1 on the construction industry.

4.1 Key Findings

- The top two materials manufactured or supplied by respondents were asphalt (72%) and aggregates (52%).
- A majority (73%) of the materials producers or suppliers were familiar with SB 1.
- From July 2018 to June 2019, respondents had supplied materials to an average of 329 projects (with a median of 75 projects), while an average of 28 projects were funded by SB 1 (with a median of 4 projects).
- A large share of respondents (46%) experienced no real increase in the number of projects for which they supplied materials, when compared to the number of supplied projects during July 2017 to June 2018. Instead, almost 32% had noticed a decrease.
- During July 2018 to June 2019, most firms (just over 90%) had been able to provide customers with the materials or products in the quantity requested.
- About 79% of respondents had an optimistic outlook for materials and product availability in the next five years. Moreover, 74% of respondents expected a steady increase in the demand of construction materials or products over the next five years.
- Since 2018, the majority (71%) of the responding firms experienced an increase in their overall unit price, where the median price increase was about 5%. Nearly 56% said that this change in overall unit prices was on par with what they had observed in recent years.
- Half (50%) of respondents attributed next year's possible unit price increases for their materials or products to increased demand due to a growing economy. Other notable reasons offered were an increased demand due to the growing number of infrastructure projects (43%) and truck driver shortages (43%). Forty percent of respondents attributed some of the cost changes to SB 1.

4.2 Emerging Conclusions

Although a plurality of respondents said that the total number of projects for which they supplied materials during July 2018 to June 2019 was comparable to the number of supplied projects from July 2017 to June 2018, about 23% said that they experienced an increase in the total number of projects. Moreover, when asked how this change compared to the changes in recent years (2013 to 2016), 48% of respondents said that the change was larger.

The majority (90%) of firms had been able to supply customers with the quantity requested during July 2018 to June 2019. Many respondents (79%) believed that there

will be good to average materials or product availability over the next five years, and a significant portion (74%) expect demand to increase over the next five years.

The overall prices of materials or products experienced an increase since 2018, and the majority of respondents (71%) expect prices of materials or products to increase into the next year. Respondents suggested that the main drivers were increased demand due to a growing economy and more infrastructure projects, as well as a shortage in truck drivers.

These observations suggest that materials suppliers or producers have not experienced a notable increase in the number of projects they supply since SB 1 was implemented. In addition, materials suppliers and producers have a positive outlook for product availability over the next five years and also expect a steady increase in product demand over the next five years.

Although the overall survey response rate is within the industry standard at 8%, the number of questions not fully completed by all respondents prevent HDR from fully extrapolating the results to the overall target population of materials suppliers and producers in California who are involved in highway and bridge construction. Nonetheless, HDR believes that the findings and conclusions from this survey are indicative of the experiences and opinions of the targeted firms. The results support a conclusion that SB 1's implementation since June 2017 is in a transitional phase, and, until more SB 1 funded projects are let, the full and anticipated effects of increased demand will not be realized.

Appendix A. Materials Supplier and Producer Questionnaire

SB 1 Impact on Construction Cost Escalation Survey

Survey length: 10 minutes

HDR Inc., an engineering consulting firm, is conducting a survey to help Caltrans understand how increased infrastructure funding from Senate Bill 1 (SB 1) will impact future highway and bridge construction costs.

Your input and firsthand experience as a supplier of essential highway and construction materials used for projects funded by SB 1 will provide much needed insight on the market of construction firms, employees and materials that help Caltrans improve transportation in California.

The survey takes about 10 minutes or less, and is entirely confidential. Your survey responses will be analyzed only after all personal identifying information is removed. Survey responses will be aggregated and not be identified in the final results. Your input will be used only for this analysis.

Please complete your questionnaire by August 25, 2019. If you have any questions about this study, please don't hesitate to contact May Raad at may.raad@hdrinc.com or you can email Mr. Joseph Dongo of Caltrans at Innovative.delivery@dot.ca.gov.

Section A: Your Firm

If you are able, please provide information about where you work to help us categorize the data.

1. Company name:
2. Job Title:
3. Email contact address:
4. City/Town:
5. Current number of employees:
6. SB/DVBE/DBE Company: Yes/No
7. If "Yes" for Question 5, which one?
8. Total Company Revenue Range
    a. Under $5 million
    b. $5–$10 million
    c. $10–$25 million
    d. $25–$50 million
    e. $50–$100 million
    f. $100 million and over

9. Which category of materials below closely reflects what your firm manufactures or supplies? You may select more than one if applicable.
    a. Asphalt
    b. Cement
    c. Concrete
    d. Aggregates
    e. Precast Concrete Products (drainage pipes, boxes, retaining wall panels, box culverts, etc.)
    f. Reinforcing Steel

g. Structural Steel
h. Misc. Metal Products
i. Precast Concrete Beams
j. Roadway Signs and Signing Components
k. Paints and Coatings (for bridge painting, wall painting, pavement markings, etc.)
l. Light and Signal Components (light and signal poles, luminaires, signal heads, and other items relating traffic signals and street lighting, etc.)
m. ITS/ATMS
n. Other, please describe

10. How many other separate facilities does your firm have?
    a. In California? ____
    b. Outside California? ____

Section B: Your Customers

11. Are you familiar with infrastructure funding through California's Senate Bill 1 (SB 1) investments?
    a. Yes
    b. Somewhat familiar
    c. No

12. For how many projects (approximately) did your firm supply materials or products to construction firms during July 2018 to June 2019?
    a. Answer _____

13. *If (a or b) in Q11, Ask:* How many of those projects were funded by SB 1?
    a. Answer _____ (enter 0 if you have not bid on any SB 1 project that you are aware of)

14. Has the number of your total projects increased or decreased compared to the projects you had during July 2017 to June 2018?
    a. Has increased
    b. Has decreased
    c. No change

15. How does this change in projects compare to changes observed in recent years (i.e., 2013 to 2016)?
    a. About the same
    b. This change is larger than in recent years
    c. The change is smaller than in recent years

16. During July 2018 to June 2019, were you able to provide your customers with the materials or products in the quantity requested?
    a. Yes, fully
    b. No, only a percentage of what was requested
    c. No

17. *If b or c selected in Q16, ASK:* What was/were the reasons your firm could not provide the full amount of the materials or products to these customers? **[Open End]**

18. *If b or c selected in Q16, ASK:* How frequently did this happen?
    a. Rarely

b. Occasionally
c. Frequently
d. Always
e. Don't know

19. *If b or c selected in Q16, ASK:* What do you think would be the reasons for the shortages? Please select all that apply.
    a. Increased demand due to growing economy
    b. Increased demand due to growing number of infrastructure projects
    c. Changing business operations
    d. Difficulties sourcing materials
    e. Tariffs
    f. Truck driver shortages
    g. Other, please describe
    h. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**

20. *If a or b in Q11 and if b or c selected in Q16, ASK:* For the times where you had challenges delivering the full amount of materials or products to your customers, how much of that could be attributed to SB 1?
    a. None
    b. Some
    c. Most
    d. All
    e. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**

21. In your opinion, what is the outlook for your materials/product's **availability** over the next 5 years? **[Open End]**
22. In your opinion, what is the outlook for your materials/product's **demand** over the next 5 years? **[Open End]**

Section C: Price Trends

23. What was the approximate percent change in your overall materials or products' unit prices since 2018? Please select one.
    a. No Change
    b. Increase of _____ percent
    c. Decrease of _____ percent

24. *If b, c selected in Q23, ASK:* Has this increase or decrease been more or less than what you have observed in recent years (i.e., 2013–2016)?
    a. Yes
    b. No

25. Do you think your overall unit prices will change next year, and if so by what percentage? Please select one.
    a. No Change
    b. Increase of _____ percent
    c. Decrease of _____ percent
    d. Don't know

26. *If b or c selected in Q25, ASK:* What do you think would be reasons for a change in your unit prices? Please select all that apply.
    a. Increased demand due to growing economy
    b. Increased demand due to growing number of infrastructure projects
    c. Issues with business operations
    d. Difficulties sourcing materials
    e. Tariffs
    f. Truck driver shortages
    g. Other, please describe
    h. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**

27. *If a or b in Q11, ASK:* For the unit price changes you've indicated, how much of the changes can be attributed to SB 1?
    a. None
    b. Some
    c. Most
    d. All
    e. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**

28. Do you have any final thoughts or comments you would like to share about how SB 1 Funding could impact the construction industry in California **[Open End]**

That completes our survey. Thank you for your time.

Appendix C

Government Transportation Staff Survey Methodology and Report

Executive Summary

The objective of the survey was to collect input and first-hand experience from government officials involved in planning, designing, and costing SB 1 funded projects. The types of questions included in the questionnaire identified and assessed possible constraints of government officials that could affect project delivery, including constraints such as the number of professionals, the number of projected vacancies, and the rate of filling vacant positions. The survey targeted Caltrans and local agency employees.

HDR administered the SB 1 Impact on Construction Cost Escalation Survey for Government Officials (survey) online starting on September 12, 2019 and ending on October 16, 2019. This survey was sent to a total of 110 government officials at Caltrans over two rounds of invitations. The overall response rate for the government officials' survey was 27.5%, although it may be lower as survey invitations were forwarded to other government staff by some of the originally invited 110 Caltrans employees.

Key Findings by Questionnaire Section

Professional Staff

- Most respondents (56%) were involved in highway, road, or bridge construction engineering services, with the remainder in planning and other services.
- The number of engineers varied significantly between offices, ranging from 2 to 200 engineers. Based on the responses, there was a median of 9 engineers and an average of 37 engineers per respondent's office.
    - Over 50% of the respondents did not have any planners, environmental professionals, or contracting and procurement professionals.
- Respondents expected that 16% to 20% (median percentage category) of current engineers would retire over the next five years. Meanwhile, 6% to 10% of planners and contracting and procurement professionals were expected to retire over the next five years.
    - Fifty percent (50%) of respondents thought that vacant engineering positions would be filled at a rate of 100%, while 32% said that engineering positions would filled at a rate of 50% to 100%.
    - Twenty-four percent (24%) of respondents thought that all other professional vacant positions would be fully replaced, and another 24% stated a replacement rate of 50% to under 100%.
- Most respondents (42%) anticipated an increase in future staffing, while 31% were unsure.
- The number of engineering students per office ranged from 0 to 10 students, with an average of 1.4 students per respondent's office. Less than 50% of respondents had any students in their offices.
    - Respondents without students in their offices believed that 76% to 80% (median category) of students will become full-time employees over the next five years.

- Respondents said that their succession plan includes good documentation, job rotation, and job shadowing.
- Respondents said that it takes 3 months (median) to fill vacancies for planners and contracting and procurement professionals, though it might take as long as 12 months.
    - It takes longer to fill engineering vacancies. In particular, respondents expected that an engineering vacancy would take a median of 6 months to fill, with a maximum value as high as 4 years (48 months).
- When comparing the rates at which vacancies are currently filled, 44% of the respondents said that it took them just as long or longer to fill the vacancies in FY2016 or prior.
    - Only 28% said that they were previously able to fill the vacancies quicker.
    - Only a third of respondents foresaw an increase in the current hiring lead time.
- Respondents believed that it takes 2 months (median) for a new recruit or new hire with 3 to 5 years of experience to become competent in the new role.

Future SB 1 funded Projects

- Respondents expected to work on a large number of projects valued between $500,000 and $10 million.
    - The results indicated a median of 23 projects per respondent's office, valued between $500,000 and $10 million over the next five years.
    - Additionally, about 10 projects per respondent's office (median) valued at less than $500,000 were expected to be built.
- Respondents expected to work on a large number of maintenance or repair projects, with a median of 25 projects per respondent's office over the next five years.
    - In addition, respondents said that the number of new construction projects they were planning to work on was a median of 10 new construction projects per respondent's office.
- Over the next five years, respondents expected to work on a median of 45 design-bid-build projects, though the numbers might range from 0 to 500 projects.
    - In comparison, over the next five years, respondents expected to work on a median of 9 construction manager/general contractor projects and a median of 1 design-build project.

Contractors' Concerns

Nearly 53% of respondents had not heard any concerns from their contractors or consultants regarding their capability to manage the increased number of infrastructure projects related to SB 1 funding. Alternatively, 29% said that they have heard concerns from their contractors or consultants.

Contents

Tables

Appendices

Acronyms and Abbreviations

Caltrans	California Department of Transportation
CMGC	construction manager/general contractor
Freq.	frequency
FY	fiscal year
Q	question
SB	Senate Bill

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1 Introduction

HDR conducted multiple surveys in California on behalf of the California Department of Transportation (Caltrans). Caltrans is interested in understanding how increasing infrastructure funding from Senate Bill 1 (SB 1) will affect future highway and bridge construction costs. The goal of SB 1 is to address a backlog of repairs and upgrades to the transportation system while ensuring a cleaner and more sustainable travel network for the future. The funding program will do so through investing $5.4 billion annually to repair California's transportation system.

Although the overall study conducted by HDR seeks to understand the effects of SB 1, one of the surveys was conducted to obtain inputs and first-hand experience from government officials in planning, designing, and costing SB 1 funded projects. This report presents the findings of that survey (the SB 1 Impact on Construction Cost Escalation Survey for Government Officials), focusing on the effects of SB 1 as observed by a sample of Caltrans employees and representatives from local and regional agencies.

The survey investigated the number of professional employees per office as well as the number of expected job vacancies over the next five years. The survey also collected information about the rate at which the projected vacant positions would be filled. In addition, through multiple-choice questions, the survey asked respondents how the current rate at which vacancies are filled compared with the rates in fiscal year 2016 or prior. When aggregated, these responses provide a sense of how ready Caltrans and other local agencies are to manage and roll out the incrementally awarded projects funded under SB 1.

The remainder of this document is divided into the following sections:

- *Section 2 – Survey Methodology* provides an overview on the survey and how the data were collected.
- *Section 0 – All 12* Caltrans districts were represented by the respondents, with Districts 3 and 6 having the largest shares of respondents at 20 percent each, followed by District 2 at 11 percent. The data from the 36 respondents to the survey are sufficient to provide trending insights from government officials and how they have been affected by SB 1 to date. However, it might be premature to extrapolate the results to all government employees involved in improving California's transportation system given that local government employees are the majority of such workers and that only a subset of Caltrans employees were directly invited.

The response rate could be as high as 27.5% (36/131). However, since HDR does not know how many invitations were forwarded to local and regional agencies or to other Caltrans employees, the response rate could be lower. Given that nearly 40 respondents provided feedback on all or some of the questions, HDR believes that the findings and conclusions from this survey represent the experiences and opinions of the targeted government officials.

- Survey Results identifies the number of valid responses received for each question.
- *Section 4 –Summary of Findings and Conclusions* summarizes relevant findings and conclusions drawn from the survey results.

2 Survey Methodology

The objective of the survey was to collect input and first-hand experience from government officials involved in planning, designing, and costing SB 1 funded projects. The survey assessed whether government officials have the capacity to plan, design, and manage the incrementally awarded projects funded under SB 1.

2.1 Sampling Frame

Caltrans provided HDR with a list of names and email addresses from Caltrans Headquarters, Caltrans districts, and various local governments.

The list included 110 government officials representing the following Caltrans departments as well as local and regional agencies:

- Cost Estimating
- Project Management
- Construction
- Design
- Programming
- Planning
- Major Maintenance

2.2 Questionnaire Development

The types of questions included in the questionnaire identified and assessed possible constraints of government officials that could affect project delivery, constraints such as the number of professionals, the number of projected vacancies, and the rate of filling vacant positions. HDR circulated the draft version of the questionnaire to Caltrans' staff to collect comments and edits. These comments and edits were incorporated before HDR finalized the questionnaire.

The survey of government officials in California consists of five components:

- *Section A – Your Department*: Department details;
- *Section B – Your Professional Staff*: Details of the number of professional employees in the office and staff turnover and hiring over the next five years;
- *Section C – Funded Projects*: Estimates of the number of projects that offices are planning to deliver over the next five years; and,
- *Section D – Contractors*: Perceptions of how contractors or consultants are dealing with the increase in infrastructure projects related to SB 1 funding.

The final questionnaire used in the online survey is included in **Error! Reference source not found.**.

2.3 Survey Administration

HDR administered the SB 1 Impact on Construction Cost Escalation Survey for Government Officials (survey) online through SurveyMonkey[1] starting on September 12, 2019 and ending on October 16, 2019. This survey was sent to a total of 110 government officials at Caltrans over two rounds of invitations. The first round invited 84 government officials, and the second round invited 26 officials. These officials represented departments for construction, cost estimation, design, major maintenance, planning, programming, and project management. The invitations sent to the officials included HDR and Caltrans phone numbers and emails in case the potential respondents had any questions or concerns about the survey.

Caltrans employees were encouraged to forward the survey to affiliated local agencies with which they have frequently collaborated. (e.g., metropolitan planning organizations, regional transportation planning agencies, etc.). This request added an additional 21 local and regional agency employees to the pool of respondents, totaling 131 invitations.

Email reminders were sent on September 20, 2019, and again on September 27, 2019, to those who had not completed the survey. All the online responses were automatically saved in a database format as SPSS[2] (Statistical Package for Social Sciences) files with fixed record layouts.

As shown in Table 1, 36 respondents started to take the survey, but only 47% completed the survey. Although the remaining 53% did not complete all questions in the survey, the questions that were completed contributed to the overall survey analysis.

Table 1. Number of Completed and Partially Completed Surveys

	Number	Percentage
Completed surveys	17	47.2%
Partially completed surveys	19	52.8%
Total surveys	**36**	**100.0%**

Table 2 shows the breakdown by agency based on the domain of the respondent's email, if it was shared. The table shows that nearly 64% of the respondents who started the survey were Caltrans employees, while 33% of the respondents were employees from local and regional agencies.

[1] SurveyMonkey Inc., San Mateo, California, USA, main website: http://www.surveymonkey.com.
[2] IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

Table 2. Employers of Survey Respondents

Employer	Number	Percent
Caltrans	23	63.9%
Local agency	12	33.3%
Missing	1	2.8%
Total surveys	**36**	**100.0%**

All 12 Caltrans districts were represented by the respondents, with Districts 3 and 6 having the largest shares of respondents at 20 percent each, followed by District 2 at 11 percent. The data from the 36 respondents to the survey are sufficient to provide trending insights from government officials and how they have been affected by SB 1 to date. However, it might be premature to extrapolate the results to all government employees involved in improving California's transportation system given that local government employees are the majority of such workers and that only a subset of Caltrans employees were directly invited.

The response rate could be as high as 27.5% (36/131[3]). However, since HDR does not know how many invitations were forwarded to local and regional agencies or to other Caltrans employees, the response rate could be lower. Given that nearly 40 respondents provided feedback on all or some of the questions, HDR believes that the findings and conclusions from this survey represent the experiences and opinions of the targeted government officials.

[3] This number includes both the number of invited government officials and respondents who visited the survey who were not part of the initial sampling frame.

3 Survey Results

This section summarizes the responses to the survey by government officials with the results presented by each component of the survey (i.e., Section A to Section D). Each table lists the number of valid survey responses received for each question as well as the valid percent frequency for each response. The valid percent frequency is based on the number of respondents who answered each question. If eligible respondents skipped a question, the count is recorded in the tables below as "No answer" for information purposes. Finally, if less than five respondents selected a response category for a given question, the question's tabulation is either collapsed or entirely suppressed to protect respondents' confidentiality, and only percentages are shown.

3.1 Section A – Your Department

Table 3 presents the responses for Section A of the questionnaire. The results showed that 56% of the respondents are involved in highway, road, or bridge construction engineering services, and the rest are involved in highway, road, or bridge construction planning and other services (44%) (Q7–A). Engineering services provides project delivery leadership for designing, constructing, and overseeing bridge and other transportation structures, while planning and other services include, but are not limited to, implementing transportation policy and planning to guide transportation investments, design policies, standards, procedures, and guidance to ensure a safe transportation system.

Respondents provided the following other categories in response to Question 7 – Part A:

- Highway maintenance
- Land surveying services for design, right-of-way, and construction
- Highway, road, or bridge project management from planning through closeout
- Prepares specifications and estimates for bridges
- Office engineer
- Innovative procurement for construction
- Maintain and update standards and procedures [Highway Design Manual (HDM), Project Development Procedures Manual (PDPM), etc.]
- Employee transportation coordinator
- Community development
- Public agency bidding construction

The majority of the respondents involved in highway, road, or bridge construction engineering services specialized in project design (65%), while the rest specialized in estimating costs and contracting and procuring projects (35%) (Q7–B).

Table 3. Details for Government Officials' Departments

Question		Responses	Valid Responses	Freq.
Q7 Part A	**Which category below most closely reflects what your office does?**	Highway/Road/Bridge Construction Engineering Services	20	56%
		Highway/Road/Bridge Construction Planning and Other services	16	44%
		No Answer	0	NA
Q7 Part B	**If b in Q7 – Part A, which highway/road/bridge construction engineering service?**	Design	11	65%
		Cost Estimation, and Contracting & Procurement	6	35%
		No Answer	3	NA

3.2 Section B – Your Professional Staff

Section B of the questionnaire asked respondents to provide the number of professional employees in their office and to project the number of vacancies over the next five years due to employees' retiring. Section B also collected information on the difficulty of filling job vacancies relative to fiscal year 2016 (FY2016) or prior.

Table 4 presents the number of professionals by profession (Q8). Although there were a median of 9 engineers per office (average of 37 engineers per office), the number of engineers varied significantly between offices. The reported number of engineers per office ranged from 2 to 200.

Other professionals such as planners, environmental professionals, and contracting professionals occurred at much lower frequencies, with less than 50% of the responding offices having any of those professionals. The average numbers ranged from 2 to 8. No examples were provided of other professions.

Table 4. Number of Professionals

Question		Professions	Responses	Results
Q8	**How many professional employees are in your office by the following job categories? If you don't have the exact number, an estimate is satisfactory.**	**Engineers**	N	27
			No answer	9
			Mean	37
			Median	9
			Maximum	200
			Minimum	2
		Planners	N	21
			No answer	15
			Mean	5
			Median	0
			Maximum	30
			Minimum	0

		Environmental professionals	N	20
			No answer	16
			Mean	8
			Median	0
			Maximum	40
			Minimum	0
		Contracting and procurement professionals	N	21
			No answer	15
			Mean	2
			Median	0
			Maximum	10
			Minimum	0
		Other professionals involved in highway/road/bridge construction not included above, please describe	N	12
			No answer	24
			Mean	30
			Median	4
			Maximum	200
			Minimum	0

Question 9 asked respondents to estimate the percentage of current professional employees who will retire over the next five years. The percentage categories from the survey's drop-down menu are presented in Table 5.

Table 5. Retirement Percentage Categories

Percentage Categories
0%
1%
2%
3%
4%
5%
6% – 10%
11% – 15%
16% – 20%
21% – 25%
26% – 30%
31% – 35%
36% – 40%
41% – 45%
46% – 50%
51% – 55%

Percentage Categories
56% – 60%
61% – 65%
66% – 70%
71% – 75%
76% – 80%
81% – 85%
86% – 90%
91% – 95%
96% – 100%

Table 6 shows the median responses by each job category. The results show that 16% to 20% (median) of current engineers are expected to retire over the next five years. In comparison, only 6% to 10% (median) of planners, contracting and procurement professionals, and environmental professionals are expected to retire over the next five years. The two respondents who provided an estimate for other professionals said that other occupations include engineering technicians and landscape associates. No examples of other professionals involved in highway, road, or bridge construction were provided.

Table 6. Percentage of Professional Employees Who Will Retire over the Next Five Years

Question		Professions	Valid Responses	Median Category	Freq.
Q9	**Over the next five years, please estimate the percentage of current professional employees who will retire by job category.**	Engineers	25	16%–20%	96%
		Planners	13	6%–10%	50%
		Contracting and procurement professionals	13	6%–10%	50%
		Environmental professionals	12	6%–10%	46%
		Other professionals involved in highway/road/bridge construction not included above, please describe	15	26%–30%	58%
		No answer	10	NA	

Question 10 asked respondents to predict the rate at which positions that are vacant due to retirement and staff turnover will be filled. Table 7 shows that 50% of the respondents thought that vacant engineering positions would be filled at 100%, while nearly 32% thought that engineering positions would be filled at a rate less than 100%, but higher than 50%. About 24% of the respondents expected to fill vacant positions for planners, environmental professionals, contracting and procurement professionals, and other professions at a 100% rate. Similarly, about 24% of the respondents expected to replace these same vacant positions at a rate higher than 50%, but less than 100%. Other occupations provided by respondents were:

- Landscape associates
- Engineering technicians

Table 7. Rate at Which Positions Left Vacant Due to Retirement and Staff Turnover Will Be Filled

Question		Job Category	Responses							
			100%		<100% and ≥50%		<50%		Don t Know	
			Valid Responses	Valid Freq.	Valid Responses	Valid Freq.	Valid Responses	Valid Freq.	Valid Responses	Valid Freq.
Q10	**Over the next five years, at what rate will you be filling in the positions left vacant due to retirement and staff turnover? Please check all that apply.**	Engineers	11	50.0%	7	31.8%	3	13.6%	1	4.5%
		Planners, Environmental professional, Contracting and Procurement professionals, and other	11	24.4%	11	24.4%	9	20.0%	14	31.1%

Question 11 asked whether the respondents anticipated a future increase in staffing. As shown in Table 8, 42% of the respondents anticipated an increase in future staffing, while 31% were unsure.

Table 8. Anticipated Increase in Staff

Question		Responses	Valid Responses	Freq.
Q11	**Do you anticipate increasing staffing in the future?**	Yes	11	42%
		Don't know	8	31%
		No	7	27%
		No answer	10	NA

Table 9 shows the number of engineering students that respondents had in their offices (Q12). The results show that the number of engineering students per office ranged between 0 and 10 students. The average number of students was 1.4 students per respondent's office. However, less than 50% of respondents had students in their offices. The average number of students among the respondents' offices that had students was nearly 4 students (3.75) per office, while the median was about 3 students.

Table 9. Number of Student Engineers per Office

Question		Responses	Valid Responses
Q12	**How many student engineers do you currently have in your office?**	N	22
		No answer	14
		Mean	1.36
		Median	0
		Maximum	10
		Minimum	0

Error! Not a valid bookmark self-reference. shows the number of student engineers that respondents believed will become full-time employees over the next five years (Q13). About 50% of respondents believed that less than 5% of the students will become full-time employees. However, this result includes those who did not have student engineers in their offices. Respondents who did have these students in their offices expected a median conversion rate of 76% to 80%.

Table 10. Percentage of Student Engineers Who Will Become Full-time Employees

Question		Responses	Valid Responses
Q13	**What percentage of these student interns do you feel will become full-time employees over the next five years?**	N	18
		No answer	18
		Median*	0%–5%
		Maximum	96%–100%
		Minimum*	0%–5%

* Range provided.

Table 11 shows the responses to Question 15, which asked respondents to describe their current succession plan and provide successful examples. Respondents said that their succession plans consisted of good documentation, rotation, and job shadowing. One respondent said, “There are enough people with experience to train the newer employees for the next 6 years. This has been the training method for decades.”

Table 11. Succession Plan Comments

Question		Comment
Q15	**Please explain highlights of your succession plan. How does it work and is it successful, for example?**	Desk Manuals, rotation, training.
		Developing manuals, Training, Document archive, employee shadowing
		Documenting process and procedures. Yes, staff using documentation to complete their work.
		Focuses on transitioning to certain professionals. Also focuses on development of processes and procedures to retain knowledge for the firm.
		Formation of teams headed by experienced professionals, so that other team members can acquire necessary knowledge from the leaders. Working with an experienced professional leader, the coworkers receive knowledge through guidance in order to produce assigned deliveries. It is not only successful, but also one of the primary way to improve/develop less experienced professionals.
		Information is electronically cataloged
		Job shadowing. Open door policy from experienced staff. Demands on time make it difficult to implement a solid succession plan.
		Multiple levels for advancement that do not require retirement or vacancy to fill, meaning in-house staff can be promoted without having to leave. Benefits, such as vacation time, also increase over time, helping to retain personnel. Many staff have been at the City for 10 plus years
		Overlapping known retires with their replacement. Don't know yet
		When the opportunity arises to rotate people through a position to allow them to gain some knowledge & understanding of the position we do. The person has to want the temp position and compete for it. We are always strategizing how to plan and prepare for a person retiring or moving to another position.
		There are enough people with experience to train the newer employees for the next 6 years. This has been the training method for decades.

		Training Engineers to be the next Senior Engineers with knowledge of how we do business. These trained Engineers will pass on the information. Also, trying to have written processes and procedures. So far it appears to be successful.
		Desk manuals, student assistants, volunteers, internship through the local high school program C.A.R.T., outreach to local grade schools, high schools and college.

Question 16 asked respondents about the time needed to fill vacant positions by job category. Based on the results (Table 12), it takes 3 months (median) to fill vacancies for planners and for contracting and procurement professionals, though it might take up to 12 months. In addition, the results show that it takes longer to fill engineering vacancies. In particular, respondents expected that an engineering vacancy would take a median of 6 months to fill, but this might take up to 4 years (48 months). No examples of other professionals were provided.

Table 12. Expected Months to Fill Vacancy

Question		Job Category	Valid Responses	Mean	Median	Range
Q16	**How many months (or range of months) do you expect it to take to fill positions by category?**	Engineers	15	10	6	0 – 48
		Planners	6	4	3	0 – 12
		Contracting and procurement professionals	6	4	3	0 – 12
		Environmental professionals, and other professionals involved in highway/road/bridge construction not included above	6	3	2	0 – 12
		No answer	21	NA		

Based on the results presented in Table 13, a large share of respondents (44%) said that it took them just as long or longer to fill vacancies in FY2016-17 or prior. Only 28% of respondents said that they were previously able to fill vacancies more quickly. Respondents were provided the opportunity to explain their responses, as shown in Table 14.

Table 13. Ability to Fill Vacancies Compared to Past

Question		Responses	Valid Responses	Freq.
Q17	**On average, were you able to fill the same job vacancies in FY2016-17 or prior faster than you can currently?**	No, same as now or took longer in FY2016 or prior	8	44.4%
		Yes	5	27.8%
		Don't know	5	27.8%
		No answer	18	NA

Table 14. Ability to Fill Vacancies Compared to Past – Comments

Question		Comment
Q17	**On average, were you able to fill the same job vacancies in FY2016-17 or prior faster than you can currently? Please explain.**	About the same
		I did not participate in filling job vacancies in Caltrans before.
		I do not have the data to support one way or the other.
		I takes longer to fill in position because new hires don't show up on time and leave early
		SB 1 has greatly diminished the pool of engineers available for hiring.
		The same requirements are basically in effect.
		We weren't allowed to hire in 2016

Question 18 asks respondents whether the current hiring lead time was expected to change during the next five years. The three original categories were collapsed to protect respondents' confidentiality. Table 15 shows that a majority (67%) of respondents said there would be no change, would take less time, or did not know. However, a third expected that it would take more time to hire during the next five years.

Table 15. Projected Changes in Ability to Fulfill Vacancies

Question		Responses	Valid Responses	Freq.
Q18	**Do you foresee this current hiring lead time as you described previously to change in the next five years?**	No change, less time or don't know	12	66.7%
		Yes it will take more time to find the right people	6	33.3%
		No answer	18	NA

Question 19 asked respondents how many months they believed it would take a new hire to become competent based on the new hire's previous work experience. Respondents said that it would take 2 months (median) for a new recruit or a new hire with 3 to 5 years' experience to become competent in the new role, as shown in Table 16. However, the respondents also said, for the same group of hires, that it could take up to 1 year (maximum) to become proficient in the new role.

Table 16. Job Training Based on Previous Work Experience

Question		Job Category	Valid Responses	Mean	Median	Range
Q19	**In your opinion, how long does it take on average for a new employee to be competent at his/her job given his/her level of experience upon hiring? Please answer in months.**	New recruit or person with 3 to 5 years' experience	7	3	2	0 – 12
		Person with 6 to 10 years' experience	6	4	3	0 – 12
		Person with over 10 years' experience	5	4	2	0 – 12
		No answer	25	NA		

3.3 Section C – SB 1 Funded Projects

Section C of the questionnaire asked government officials to provide details regarding the number of SB 1 funded projects their offices are planning to work on over the next five years, as well as to identify project characteristics such as the project type and delivery method.

Respondents estimated that a median of 23 projects valued at $500,000 to $10 million will be built during the next five years. Projects valued lower or higher were estimated in similar quantities, ranging from a low median of 2 projects valued at $100 million to $1 billion to a high median of 10 projects valued at less than $500,000. Three-quarters of the respondents thought no projects over $1 billion would be built during the next five years. For those that did, the numbers provided ranged from 1 to 20 projects.

Table 17: Estimated Future Projects by Project Size

Question		Project Size	Responses	Results
Q20	**Please provide an estimate of the number of projects your office is planning to work on (e.g., plan, design, cost estimation, procurement/contracting, etc.) in the next five years by project size.**	**< $500,000**	N	11
			No answer	25
			Mean	26
			Median	10
			Maximum	200
			Minimum	0
		$500,000 to $10 million	N	10
			No answer	26
			Mean	47
			Median	23
			Maximum	150
			Minimum	0
		$10 million to $100 million	N	12
			No answer	24
			Mean	21
			Median	8

			Maximum	100
			Minimum	0
		$100 million to $1 billion	N	11
			No answer	25
			Mean	6
			Median	2
			Maximum	50
			Minimum	0
		> $1 billion	N	8
			No answer	28
			Mean	3
			Median	0
			Maximum	20
			Minimum	0
		Unknown value	N	1
			No answer	35

Question 21 asked respondents to estimate the number of projects, by project type, that their offices plan to work on over the next five years. The results, shown in Table 18, show that they are planning a large number of maintenance or repair projects for the state highway system, with a median of 25 projects per respondent's office over the next five years.

In addition, several respondents said that they plan to work on new construction projects. Over the next five years, respondents expect to work on a median of 10 new construction projects.

Table 18: Estimated Future Projects by Project Category and Type

Question		Project Category	Valid Responses	Median Number of Projects
Q21	**Along the same lines, please provide an estimate of the number of projects your office is planning to work on in the next five years by project work type.**	Maintenance/Repair	19	25
		Expansion	16	5
		New Construction	14	10
		Local streets and roads*	2	13
		No Answer	23	NA

* Respondents indicated local streets and roads as *other*.

Question 22 asked respondents to estimate the number of projects by delivery method that their offices plan to work on over the next five years. The results, presented in Table 19, show that respondents expect to work on a median of 45 design-bid-build projects over the next five years, though the number of projects could reach 500. In comparison, over the next five years, respondents expect to work on a median of 9 construction manager/general contractor (CMGC) projects and a median of 1 design-build project. No other delivery methods were provided. HDR noted that only a small number of

respondents answered this question, possibly reflecting that not all are aware of the details of programmed projects.

Table 19. Estimated Future Projects by Delivery Method

Question		Project Delivery Method	Responses	Results
Q22	**Finally, please provide an estimate of the number of projects your office is planning to work on in the next five years by delivery method.**	**Design-Bid-Build**	N	9
			No answer	27
			Mean	103
			Median	45
			Maximum	500
			Minimum	0
		CMGC (Construction Manager/General Contractor)	N	8
			No answer	28
			Mean	16
			Median	9
			Maximum	50
			Minimum	0
		Design-Build	N	7
			No answer	29
			Mean	3
			Median	1
			Maximum	10
			Minimum	0
		Other	N	1
			No answer	35

3.4 Section D – Contractors

Section D of the questionnaire asked respondents to provide concerns that contractors or consultants have expressed regarding their capability to manage the increased number of infrastructure projects related to SB 1 funding. Nearly 53% of respondents who answered this question said that they have not heard any concerns, but 29% of respondents said that contractors or consultants have expressed concerns, as shown in Table 20.

Table 20: Contractors' Possible Concerns Regarding Capacity to Manage Projects Related to SB 1 Funding

Question		Responses	Valid Responses	Freq.
Q23	**Have your contractors/consultants expressed any concerns as to whether they have the capacity to manage the increase in infrastructure projects related to SB 1 funding?**	Yes	5	29.4%
		No	9	52.9%
		Don't know	3	17.6%
		No Answer	19	NA

Question 24 asked respondents for their opinion about the possible causes of concerns expressed by contractors or consultants. A common theme from respondents was the inability to find either skilled or general construction labor. Another reason provided by a respondent mentioned the limited number of "truck drivers or trucks to satisfy the demand during peak season." Other reasons provided by respondents were:

- "Difficulty getting participation from specialty subcontractors"
- "Quality control of plans and & spec vs delivery schedule. Quality compromised at tax payers' expense"

Question 25 asked respondents to provide additional insights regarding why contractors believed that they might not be able to meet demand from the increase in infrastructure projects. The following two comments were provided:

- "There are actually not enough paving jobs out there right now for the construction industry to bid and they are wondering where all the SB 1 $ are at. At the same time Caltrans staff is charging exuberant [number] of hrs. and there is little to show the taxpayer."
- "In conversations with contractors, they have said that SB 1 has completely flooded the market with work and there are inadequate labor, materials, and equipment resources available, leading to greatly increased construction costs."

3.5 Final Thoughts or Comments

Table 21 lists the compiled final thoughts and comments provided by respondents.

Table 21: Comments on How SB 1 Funding Could Affect the Construction Industry in California

Question		Comment
Q26	**Please feel free to add any insight you would have to help us better understand why vendors feel they may not be able to meet demand from the increase in infrastructure projects.**	Expenses in hiring professionals and procuring materials is expected to increase about 5%. SB 1 Funding will have overall positive impact on California infrastructures development.
		I hear the new Governor is going to take SB 1 $ to construct homeless shelters in state right of way. If Caltrans was as efficient as it claims to be then there would be no need for SB 1 tax. People would get a credit back at gas pump.
		Not knowing what is in the pipeline for funding is frustrating and causes rash hiring or rash firing or reallocation of resources that waste public funds.
		SB 1 Funding has provided a substantial increase in the available funding towards large projects, leading to larger maintenance contracts for paving and highway projects, but it remains to be seen how the funds will get distributed and benefit smaller projects (and therefore small engineering firms and contractors). Pricing has steadily increased in both design fees and construction contracts as the labor market continues to tighten. SB 1 will continue to stimulate the industry, however, if the rest of the economy starts to slow, SB 1 may disproportionately benefit larger contractors and engineering firms that are able to take on these projects.
		The funds from SB 1 have and will help keep CA's infrastructure repaired and maintained to a fair or good condition. These funds were badly needed and the results of having more funds to maintain the system is being seen. However, the cost of doing more business with the contractors has increased, which means the funds don't go as far as assumed.
		The immediate increase in workload and projects is anticipated to plateau or reduce as funding sources are impacted by shrinking revenues.
		The industry should expect to do increased workload due to SB – funding
		Yes, it makes it harder to hire and things are now more expensive, BUT the benefits of SB 1 are exponentially larger.

4 Summary of Findings and Conclusions

This section synthesizes the survey results to identify trends and possible effects of SB 1 on the capacity of government officials to plan and manage incremental SB 1 funded projects.

4.1 Key Findings by Section

4.1.1 Professional Staff

- Most respondents (56%) were involved in highway, road, or bridge construction engineering services, with the remainder in planning and other services.
- The number of engineers varied significantly between offices, ranging from 2 to 200 engineers. Based on the responses, there was a median of 9 engineers and an average of 37 engineers per respondent's office.
    - Over 50% of the respondents did not have any planners, environmental professionals, or contracting and procurement professionals.
- Respondents expected that 16% to 20% (median percentage category) of current engineers would retire over the next five years. Meanwhile, 6% to 10% of planners and contracting and procurement professionals were expected to retire over the next five years.
    - Fifty percent (50%) of respondents thought that vacant engineering positions would be filled at a rate of 100%, while 32% said that engineering positions would filled at a rate of 50% to 100%.
    - Twenty-four percent (24%) of respondents thought that all other professional vacant positions would be fully replaced, and another 24% stated a replacement rate of 50% to under 100%.
- Most respondents (42%) anticipated an increase in future staffing, while 31% were unsure.
- The number of engineering students per office ranged from 0 to 10 students, with an average of 1.4 students per respondent's office. Less than 50% of respondents had any students in their offices.
    - Respondents who did have students in their offices believed that 76% to 80% (median response category) of students would become full-time employees over the next five years.
- Respondents said that their succession plan includes good documentation, job rotation, and job shadowing.
- Respondents said that it takes 3 months (median) to fill vacancies for planners and contracting and procurement professionals, though it might take as long as 12 months.

- It takes longer to fill engineering vacancies. In particular, respondents expected that an engineering vacancy would take a median of 6 months to fill, with a maximum value as high as 4 years (48 months).

- When comparing the rates at which vacancies are currently filled, 44% of the respondents said that it took them just as long or longer to fill the vacancies in FY2016 or prior.
  - Only 28% said that they were previously able to fill the vacancies quicker.
  - Only a third of respondents foresaw an increase in the current hiring lead time.
- Respondents believed that it takes 2 months (median) for a new recruit or new hire with 3 to 5 years' experience to become competent in the new role.

4.1.2 Future SB 1 funded Projects

- Respondents expected to work on many projects valued between $500,000 and $10 million.
  - The results indicated a median of 23 projects per respondent's office, valued between $500,000 and $10 million over the next five years.
  - Additionally, about 10 projects per respondent's office (median) valued at less than $500,000 were expected to be built.
- Respondents expected to work on many maintenance and/or repair projects, with a median of 25 projects per respondent's office over the next five years.
  - In addition, respondents said they planned to work on a median of 10 new construction projects per respondent's office.
- Over the next five years, respondents expected to work on a median of 45 design-bid-build projects, though the numbers might range from 0 to 500 projects.
  - In comparison, over the next five years, respondents expected to work on a median of 9 CMGC projects and a median of 1 design-build project.

4.1.3 Contractors' Concerns

Nearly 53% of respondents had not heard any concerns from their contractors or consultants regarding their capability to manage the increased number of infrastructure projects related to SB 1 funding. Alternatively, 29% said that they have heard concerns from their contractors or consultants.

4.2 Emerging Conclusions

As SB 1 funding is rolled out over the current and future fiscal years, staffing levels will need to be at a minimum maintained, and optimally increased, so that Caltrans can efficiently plan and manage the incremental projects funded by SB 1. The responses from the government officials who participated in the survey corroborate staffing budget

trends available from Caltrans.[4] Between FY2011-12 to FY2016-17, Caltrans' staffing numbers steadily decreased such that staff numbers dropped by 6.8%, with numbers in May 2017 being the lowest in a decade.[5] However, since May 2017, Caltrans has been steadily hiring. An article available from the Legislative Analyst's Office estimated that, between May 2017 and March 2018, Caltrans hired on average 53 employees and lost 41 each month, for a net increase of 12 each month. [6]

The survey respondents said that they expect about 16% to 20% of their engineering staff to retire over the next five years (about 3.6% per year). This is a high retirement rate compared to what the Bureau of Labor Statistics reports for the national annual average "other separation" rate[7] for professional services (only 0.3% per year).[8] In fact, a 2018 report available from Caltrans stated that, for every five new hires by Caltrans, four employees retire.

Given this retirement surge, respondents said (at a rate of 42%) that their offices planned to increase staffing levels and that vacant engineering positions would be replaced at rates of at least 50% (32% of respondents) to a maximum of 100% (50% of respondents). The comments provided by the respondents regarding succession plans indicated that Caltrans has been proactive in transferring in-house knowledge and can quickly bring new recruits up to speed for optimal job performance.

However, with the lead times to hire key skills in engineering services ranging from 6 months to 4 years, Caltrans will need to keep up the pace with its planned job fairs and advertisements, and might also need to use recruiting agencies. One mitigating factor is the high rate of retaining student engineers. Respondents who have interns in their offices estimated that 76% to 80% of these student engineers would be hired within the next five years.

Respondents estimated the number of SB 1 funded projects by size and project category over the next five years. Maintenance and rehabilitation projects were estimated at a median value of 25 such projects per respondent's office with typical values ranging from $500,000 to $10 million per project. Other project categories for new construction and expansion had lower expected numbers per respondent's office (10 and 5 projects, respectively). These responses in line with the allocation of SB 1 funds, in which the majority (66%) of annual SB 1 funds are directed toward the road maintenance and rehabilitation account, including maintenance and State Highway Operations Protection Program projects under the State Highway Account.[9]

Responded overwhelmingly chose design-bid-build as the delivery method for future SB 1 funded projects, with a median of 45 such projects over the next five years per respondent's office, followed by CMGC at a median of 9 projects and design-bid at a

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[4] https://dot.ca.gov/-/media/dot-media/programs/public-affairs/documents/mm-2019-winter-budget-a11y.pdf, accessed November 20, 2019.

[5] https://dot.ca.gov/-/media/dot-media/programs/public-affairs/documents/mm-2018-q2-recruitment-a11y.pdf, accessed November 20, 2019.

[6] https://lao.ca.gov/Publications/Report/3833, accessed November 20, 2019.

[7] Other separations includes separations due to retirement, death, disability, and transfers to other locations of the same firm.

[8] https://www.bls.gov/news.release/pdf/jolts.pdf, accessed November 20, 2019.

[9] Data provided by Thuy Nguyen of Caltrans, November 8, 2019.

median of only 1 project. Although design-bid-build is currently the most common delivery method for Caltrans highway or bridge construction projects, Caltrans' ability to hire multiple contractors as prescribed by this method under one main contract could be curtailed if contractor capacity is reduced in a construction market of increased demand.

Caltrans staff work closely with their contractors and hear about the issues that contractors face daily. The majority (53%) of respondents had not heard any concerns from contractors related to the increased demand from SB 1 funds, while 29% of respondents said that contractors had expressed concerns. This disparity reflects the fact that the full potential of SB 1 funding has not "hit the streets," and the pressures experienced by contractors are not homogenous across all types of contractors and geographies in California.

One respondent said, "There are actually not enough paving jobs out there right now for the construction industry to bid and they are wondering where all the SB 1 $ are at." Another respondent offered an opposite observation, saying, "In conversations with contractors, they have said that SB 1 has completely flooded the market with work and there are inadequate labor, materials, and equipment resources available, leading to greatly increased construction costs."

Finally, the respondents' comments show a general attitude that SB 1 funding will bring benefits to California's transportation system. However, respondents are aware that construction costs will increase due to the increased demand (some are already observing this) and that Caltrans can attain greater efficiencies through better management.

Appendix A. Government Officials Questionnaire

SB 1 Impact on Construction Cost Escalation Survey

Survey length: 10 minutes

HDR Inc., an engineering consulting firm, is conducting a survey to help Caltrans understand how increased infrastructure funding from Senate Bill 1 (SB 1) will impact future highway and bridge construction costs.

SB 1 invests $5.4 billion annually through 2027 to fix California's transportation system. It will address a backlog of repairs and upgrades, while ensuring a cleaner and more sustainable travel network for the future.

Your input and firsthand experience planning, designing and costing projects funded by SB 1 will provide much needed insight on whether Caltrans has the capacity in terms of enough employees with the required skill sets and whether the construction industry has such the capacity to help Caltrans meet its goals to improve transportation for California's citizens and businesses.

The survey is entirely confidential. Your survey responses will only be analyzed after all personal identifying information is removed. Survey responses will be aggregated and used only for the analysis.

Please complete your questionnaire by September 30, 2019. If you have any questions about this study, please don't hesitate to call May Raad at 1-877-687-4634/email at may.raad@hdrinc.com or you can email Mr. Joseph Dongo of Caltrans at Innovative.delivery@dot.ca.gov.

Section A: Your Department

Please provide information about the place where you work to help us categorize the data.

1. Department/Agency Name:
2. Division/Office:
3. Name:
4. Job Title:
5. Email contact address:
6. Town/City/County:

7. Which category below most closely reflects what your office does?
    a. Highway/Road/Bridge Construction Planning
    b. Highway/Road/Bridge Construction Engineering Services
        i. Design
        ii. Cost estimation
        iii. Contracting and Procurement
    c. Other, please describe

Section B: Your Professional Staff

8. How many professional employees are in your office by the following job categories? If you don't have the exact number, an estimate is satisfactory.
    a. Engineers ____
    b. Planners ____

c. Environmental professional ____
d. Contracting and Procurement professionals ____
e. Other professional involved in Highway/Road/Bridge Construction not included above, please describe ____

9. Over the **next 5 years**, please estimate the percentage of current professional employees which will retire by job category?
   a. Engineers ____
   b. Planners ____
   c. Environmental professionals ____
   d. Contracting and Procurement professionals ____
   e. Other professional involved in Highway/Road/Bridge Construction not included above, please describe ____

10. Over the **next 5 years**, at what rate will you be filling in the positions left vacant due to retirement and staff turn-over? Please check all that apply.

Job Category	100 percent	50 -< 100 percent	<50 percent	Don't know
Engineers				
Planners				
Environmental professional				
Contracting and Procurement professionals				
Other, Please describe				

11. Do you anticipate increasing staffing in the future?

12. How many student engineers do you currently have in your office?

13. What percentage of these student interns do you feel will become full-time employees over the **next 5 years**?

14. Do you have a succession plan in place to retain in-house knowledge?
   a. Yes
   b. No
   c. Don't know

15. If "a" in Q14, ASK: Please explain highlights of your succession plan? How does it work and is it successful for example. **[Open End]**

16. How many months (or range of months) do you expect it to take to fill positions by category?
   a. Engineers ____
   b. Planners ____
   c. Environmental professional ____
   d. Contracting and Procurement professionals ____
   e. Other, Please describe ____

17. On average, were you able to fill the same job vacancies in FY2016 or prior faster than you can currently?
    a. Yes
    b. No, same as now
    c. No, it took longer in FY2016 or prior
    d. Don't know
    e. Can you please explain your answer? **[OPEN END]**

18. Do you foresee this current hiring lead time as you described previously to change in the **next 5 years**?
    a. No change
    b. Yes, it will take longer to find the right people
    c. Yes, it will take less time to find the right people
    d. Don't know
    e. Can you please explain your answer? **[OPEN END]**

19. In your opinion, how long does it take on average for a new employee to be competent at his/her job given his/her level of experience upon hiring? Please answer in months.
    a. New recruit _____
    b. Person with 3 to 5 years' experience _____
    c. Person with 6 to 10 years' experience _____
    d. Person with over 10 years' experience _____
    e. Can you please explain your answer? **[OPEN END]**

Section C: SB 1 Funded Projects

20. Please provide an estimate of the number of projects your office is planning to work on (e.g., plan, design, cost estimation, procurement/contracting, etc.) in the **next 5 years** by project size?
    a. <$500,000 ____
    b. $500,000 to $10 million ____
    c. $10 million to $100 million ____
    d. $100 million to $1 billion ____
    e. > $1 billion ____
    f. Value unknown ____

21. Along the same line, please provide an estimate of the number of projects your office is planning to work on in the **next 5 years** by project work type?

Project Work Type	Local Roads	State Bridge and Culvert	State Highway System
Maintenance/Repair			
Expansion			
New Construction			
Other, please describe			

22. Finally, please provide an estimate of the number of projects your office is planning to work on in the **next 5 years** by delivery method.

a. Design-bid-Build ____
b. Design-Build ____
c. CMGC (Construction Manager/General Contractor) ____
d. Other, please describe _____ ____

Section D: Contractors

23. Have your contractors/consultants expressed any concerns as to whether they have the capacity to manage the increase in infrastructure projects related to SB 1 funding?
    a. Yes
    b. No
    c. Don't know _____

24. What in your opinion would be the reason for their concerns? Please select all that apply.
    a. Finding the right skilled labor
    b. Finding general construction labor
    c. Challenges in obtaining construction materials such as asphalt, concrete, cement, etc.
    d. Any other reason, please describe.

25. Please feel free to add any insight you would have to help us better understand why vendors feel they may not be able to meet demand from the increase in infrastructure projects. **[Open End]**

26. Do you have any final thoughts or comments you would like to share about how SB 1 Funding could impact the construction industry in California. **[Open End]**

That completes our survey. Thank you for your time.

Appendix D

Associations Survey Methodology and Report

Executive Summary

The objective of the survey was to collect knowledge to date on demand and supply conditions from associations whose members are part of the construction industry in California. The types of questions included in the questionnaire identified and assessed the possible effects and constraints on business growth for the associations' members whether the associations are construction firms, material suppliers or producers, or trucking firms.

HDR administered the SB 1 Impact on Construction Cost Survey for industry and trade associations online starting on August 13, 2019, and ending on September 30, 2019. The survey was sent to 246 construction trade and industry associations. However, 51 of those emails were no longer valid, leaving 195 associations who received the online survey invitations. At the end of the survey collection, 8 associations (2 of which were major construction industry associations) participated in the study. The overall response rate for the association survey was 4.1%.

Due to the small sample size, the analysis of the survey results is qualitative. Through the respondents' informed perspectives, it provides some insight into the current state of the California highway and bridge construction industry as of mid-2019.

Key Findings by Questionnaire Section

Association

- All eight of the respondents said that their associations were familiar or somewhat familiar with SB 1.

Members

- The number of association members provided by respondents ranged from 75 to 70,000. The median number of members was 876 members, while the average was 15,001 members.
- When asked about their members' construction outlook over the next five years, all respondents responded in the positive by seeing either an increase in business or holding course. None of the respondents said that their members believe there will be a downturn in business. Five of the respondents attributed some to all of the positive growth changes to SB 1.
- Three respondents said that their members have experienced difficulties finding employees with the right skill set since 2018. Three other respondents said that their members did not experience difficulties finding the right skill. One respondent was unsure whether their members experienced such difficulties.
- Two respondents said that it is more difficult now to find the right skill set compared to recent years. Three other respondents said that the environment is similar to what has been observed in recent years. One respondent said that the process of finding the right skill set is evolving.

- The majority of non-union respondents said that their members had to increase their wages since 2018 to attract the right talent and labor.
- Non-union associations said that their members expect overall wages in the industry to increase next year. The respondents attributed some of these wage increases to SB 1.

Construction Firms and Construction Workers

- Seven respondents said that their associations support construction firms or construction workers.
- These respondents had varying opinions about whether their members experienced difficulties or longer wait times when ordering construction materials since 2018. One respondent said that their members experienced difficulties, two said that their members did not have any difficulties, and four were unsure.

Materials Suppliers and Manufacturers

- Five of the eight responding associations support materials suppliers and manufacturers.
- Two respondents said that their members have experienced difficulties supplying their customers with construction materials since 2018. These respondents said that their members struggle to supply aggregates, asphalt binder, and concrete.
- Three respondents said that their members plan to increase their overall unit prices in the next year. The percentage increase provided by these associations was in the 2% to 5% range. One respondent attributed some of this price change to SB 1.

Trucking Firms

- Respondents from the three associations that represent trucking firms shared differing viewpoints as to whether their members had difficulties meeting the demand for trucking or freight services since 2018. Two respondents said that their members had not experienced difficulties, while the other one was unsure.
- One respondent said that their members will increase their shipping costs (in this case, by 4%), and that some of the shipping cost increase could be attributed to SB 1. The other two respondents were unsure.

Contents

Tables

Appendices

Acronyms and Abbreviations

Caltrans	California Department of Transportation
NAICS	North American Industry Classification System
SB	Senate Bill

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1 Introduction

HDR conducted multiple surveys in California on behalf of the California Department of Transportation (Caltrans). Caltrans is interested in understanding how increasing infrastructure funding from Senate Bill 1 (SB 1) will affect future highway and bridge construction costs. The goal of SB 1 is to address a backlog of repairs and upgrades to the transportation system while ensuring a cleaner and more sustainable travel network for the future. The funding program will do so through investing $5.4 billion annually to repair California's transportation system.

Although the overall study conducted by HDR seeks to understand the effects of SB 1, one of the surveys was conducted to understand the effects SB 1 has on demand and supply conditions from associations through their input as trade and industry association leaders. This report presents the findings of that survey (the SB 1 Impact on Construction Cost Survey for Associations), focusing on the effects of SB 1 as observed by a sample of trade and industrial associations in California.

The survey collected associations' perceptions regarding the industry outlook of their members as well as the availability of employees and the effect on wages. Most importantly, the survey asked, through open-ended questions, about any struggles the associations' members have experienced when ordering, supplying, or transporting construction materials since 2018.

Due to the small sample size, the analysis of the survey results is qualitative. Through the respondents' informed perspectives, it provides some insight into the current state of the California highway and bridge construction industry as of mid-2019.

The remainder of this report is divided into the following sections:

- *Section 2 – Survey Methodology* provides an overview of the survey and how the data were collected.
- *Section 3 – Survey Results* identifies the number of valid responses received for each question.
- *Section 4 – Summary of Findings and Conclusions* summarizes relevant findings and conclusions drawn from the survey results.

2 Survey Methodology

The objective of the survey was to collect knowledge to date of demand and supply conditions from associations whose members are part of the construction industry in California. Specifically, the survey assessed the possible effects of SB 1 on the overall supply and demand in the construction industry and whether, from the perspective of trade and industry associations, Caltrans' roster of contractors and material suppliers in California have the capacity to bid on the volume of work anticipated over the next several years.

2.1 Sampling Frame

In order to invite targeted associations to complete the survey, HDR prepared a list of these associations' names, phone numbers, and email addresses in California using data purchased on August 6, 2019, from ReferenceUSA.[1] The list of purchased contact information of relevant trade associations was composed of businesses with the NAICS[2] codes presented in Table 1.

Table 1. NAICS Codes for Industry and Trade Associations

Description	NAICS Code
Business and trade organizations	81391004
Labor organizations	81393001
Unions – industrial	81393002

2.2 Questionnaire Development

The types of questions included in the questionnaire identified and assessed the possible effects and constraints on business growth for the associations' members whether the associations are construction firms, material suppliers or producers, or trucking firms. For example, the questionnaire asked the respondents the difficulties their members have experienced ordering, supplying, and transporting construction materials since 2018. HDR circulated the draft version of the questionnaire to Caltrans' staff to collect comments and edits. These comments and edits were then incorporated before the questionnaire was finalized.

The questionnaire for construction industry and trade associations consisted of five components:

- *Section A – Your Association*: Association details
- *Section B – Your Members*: Details of the number of members, and the general view of their members regarding the construction outlook, and how much of this expectation can be attributed to SB 1

[1] ReferenceUSA, Dallas, Texas, USA, main website: http://resource.referenceusa.com/.

[2] The North American Industry Classification System (NAICS) is used by the United States, Canada, and Mexico to classify businesses by industry. Website: https://www.census.gov/smallbusiness/html/naics.html.

- *Section C – Construction Firms/Construction Workers*: Respondents' opinions regarding any struggles their member have experienced when ordering construction material since 2018, and how this compares to recent years (2013 to 2016)
- *Section D – Materials Suppliers/Manufacturers*: Respondents' opinions regarding any struggles their members have experienced when supplying construction materials since 2018, and how this situation compares to recent years (2013 to 2016)
- *Section E – Trucking Firms*: Respondents' opinions regarding any struggles their members have experienced when transporting construction materials since 2018, and how this situation compares to recent years (2013 to 2016).

The final questionnaire used in the study is in Appendix A of this report.

2.3 Survey Administration

HDR administered the SB 1 Impact on Construction Cost Escalation Survey for industry and trade associations (survey) online through SurveyMonkey[3] starting on August 13, 2019, and ending on September 30, 2019. The survey was sent to 246 construction trade and industry associations. However, 51 of those emails were no longer valid, leaving 195 associations who received the online survey invitations. The invitations sent to the targeted associations included HDR and Caltrans phone numbers and emails in case the potential respondents had any questions or concerns about the survey.

Email reminders were sent to those who had not completed the survey by August 20, 2019. A total of 21 associations that had not completed the survey by September 3, 2019, were contacted by phone as a reminder and as an opportunity to provide them additional support if needed. All the online responses were automatically saved in a database format as SPSS[4] (Statistical Package for Social Sciences) files with fixed record layouts.

As shown in Table 2**,** eight respondents started to take the survey, and seven of the eight completed the survey. The completed questions from the one respondent who did not completed all the questions did contribute to the overall analysis. The response rate for this survey was 4.1% (8/195).

Table 2. Number of Completed and Partially Completed Surveys

Survey Type	Number	Percentage
Completed surveys	7	87.5%
Partially completed surveys	1	12.5%
Total surveys	**8**	**100.0%**

[3] SurveyMonkey Inc., San Mateo, California, USA, Main Website: www.surveymonkey.com
[4] IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

3 Survey Results

This section summarizes the responses to the survey by associations with the results presented by each component of the survey (that is, Section A to Section E). Due to the low number of responses, these results are of a qualitative nature and might not represent the experiences and opinions of all the targeted trade and industry associations in California.

3.1 Section A – Your Association

Section A of the questionnaire asked respondents to provide information regarding their association. Question 5 asked respondents if they were familiar with SB 1. All eight respondents stated that they were familiar or somewhat familiar with SB 1.

3.2 Section B – Your Members

Section B of the questionnaire asked respondents to provide details regarding the number of members in their association, the general construction outlook of their members, and how much of this outlook can be attributed to SB 1. Section B also asked respondents whether their members had to increase wages since 2018 in order to attract the right talent and labor. The results per question are discussed below.

Question 6 – How many association members do you have?

The number of association members provided by respondents ranged from 75 to 70,000. The median number of members was 876 members, while the average was 15,001 members.

Question 7 – What is the general view of your members regarding the construction outlook over the next five years?

Three respondents said that their members expect to see a growth in business. One respondent said that the reason why their members have a positive outlook is the extra funding that SB 1 creates, which will deal with reducing the backlog of infrastructure projects. Another respondent attributed the positive outlook of their members to the local jobs that SB 1 will create. Two of the respondents said that their members feel that growth is similar to what has been observed in the past five years. None of the respondents said that their members expect a downturn in business over the next five years. The comments that were offered are provided in Table 3.

Table 3. Reasons for Members' Outlook

Reasons why your members are viewing a growth in business
The extra funding will create numerous jobs by reducing a backlog of infrastructure projects.
Sb1 funding will provide local jobs with secure $$
Generally, with the passage of SB 1, and success of many self-help county measures, our members have had a positive outlook on what they expect this to mean for future work. However, there are persistent reports that SB 1 has not generated the significant boost in business that had been expected, particularly in rural areas. The construction outlook for the private sector is somewhat mixed, which also is sending somewhat mixed signals on the forecast for future work.
Reasons why your members are unsure of the construction outlook
In my position I don't have contact with the members
We are a labor compliance group. We don't tend to inquire about industry feelings toward the market's health at any given point.
It seems like housing market not expanding, SB 1/transportation spending taking longer to reach projects than expected, and general concern about direction of economy.
Reasons why your members are seeing a similar construction outlook to what has been observed
3 years of back log on the books
From the jobs we are told are coming.

Question 12 – Based on what you have observed regarding your members' views on business growth over the next five years, how much of their expectations can be attributed to SB 1?

Three respondents said that some of their members' views can be attributed to SB 1. One respondent attributed all of their members' expectations to SB 1, while another respondent attributed most of their expectations to SB 1.

Question 13 – Have your members experienced difficulties finding the right skill set since 2018?

Three respondents said that their members have struggled to find employees with the right skill set since 2018. One respondent said that the problem could be attributed to the younger generation not being interested in trade jobs, as well as the highly competitive market. Another respondent said that their members are in short supply of "people that will work with their hands." Table 4 lists all of the reasons provided by respondents regarding why their members have struggled to find workers. According to respondents, the following skills are in short supply:

- Craft workers
- Material laboratory technicians
- Engineers
- Inspectors
- Equipment operators
- Mechanics
- Drivers.

Table 4. Reasons Why Associations' Members Have Difficulty Finding Workers

Question		Comments
Q13 Part A	**If *a* in Q13, please elaborate; we are looking for reasons as to why you think this could be happening.**	High school only prepares for college not vocational skills
		The construction industry in general, and the asphalt industry in particular, have had a difficult time recruiting and retaining workers, particularly at the craft level. This is a chronic problem for virtually every company, and is prominently featured in our association's strategic plan.
		In general, seems less people interested in technical trades, and there has been strong job competition from other sectors due to low unemployment.

Four of the respondents said that their members did not experience difficulties finding the right skill set since 2018. The reasons provided by the respondents are listed in Table 5. The majority of the respondents stated that their members have not experienced a shortage of workers since they have access to training and apprenticeship programs. One respondent was unsure whether their members experienced difficulties finding the right skill set.

Table 5. Reasons Why Associations' Members Did Not Have Difficulty Finding Workers

Question		Comments
Q13 Part B	**If *b* in Q13, please elaborate; we are looking for reasons as to why you think this could be happening.**	Operating Engineers trains Apprentice's and trains Journeymen each year at our school.
		We offer multiple Journeyman upgrade classes along with our 5 year apprenticeship.
		Our members have access to training and apprenticeship programs that are of no cost to the member.
		We have an Apprenticeship which trains our new entry members into skilled Journeymen

Question 14 – How does finding the right skill set compare to recent years (i.e., 2013 to 2016)?

Two respondents said that it is more difficult now to find the right skill set when compared to recent years (2013 to 2016). One respondent said that the current situation is "bad and getting worse." The other respondent said, "It is more difficult. Unemployment is lower, and we need more workers due to the steady expansion of the economy since 2009."

Another three respondents said that the availability of essential skill sets is similar to what they had observed in recent years. However, one added that their members expect an increase in demand for workers, specifically: "Similar, but with the increase in construction dollars spent, the demand for workers has also increased." One respondent

said that their organization is a union, and that this question does not apply to them as much, since they provide training to their members from the beginning.

One respondent said that they believe the process of finding the right skill set is evolving. The respondent said, "I would say it is evolving as more millennials look to go into construction. They value their time over financial success."

Question 15 – Is your association a union?

Five respondents said that their associations were unions, while three said that they were not.

Question 16 – Have your members had to increase wages since 2018 in order to attract the right talent and labor?

This question was presented to non-union associations only. Two respondents said that their members had to increase their wages since 2018, while one respondent was unsure. Table 6 shows the reasons why this could be happening. One respondent said that the purpose of the increase in wages is "to retain labor." Another respondent alluded to "ineffective and uncoordinated recruitment efforts" as the reason for higher wages. According to respondents, occupations that have experienced an increase in wages are:

- Operators
- Dredge hangs
- Survey operators.

Table 6. Reasons Why Wages Are Increasing

Question		Comments
Q16 Part A	**If *b* in Q15, please elaborate; we are looking for reasons as to why you think this could be happening.**	To retain top labor
		Ineffective and uncoordinated recruitment efforts, and lack of a robust campaign to extol the virtues of working in the industry, dispel myths, etc. Recruitment of women to the industry has been abysmal, with women representing roughly 7% of the work force.

Question 17 – Have your members indicated that their overall wages for their industry will change next year, and, if so, by what percentage (approximately)? Please select one.

Two non-union respondents said that their members expect overall wages to increase next year by 3% to 4%. One respondent was unsure.

Question 18 – For the wage changes you've indicated, how much of the changes can be attributed to SB 1?

Respondents said that only some of the wage increases could be attributed to SB 1.

3.3 Section C – Construction Firms/Construction Workers

Section C of the questionnaire asked respondents to provide details regarding any struggles their members have experienced when ordering construction materials since 2018, and how this situation compares to recent years (2013 to 2016).

Question 19 – Does your association support construction firms and/or construction workers?

Seven respondents said that their association supports construction firms or construction workers. Only one respondent said that their association does not.

Question 20 – Have your members experienced difficulties or longer wait times when ordering construction materials since 2018?

Four respondents said that they are unsure, while two respondents said that their members did not experience difficulties when ordering construction materials.

Only one respondent said that their members experienced problems when ordering materials since 2018—specifically when ordering aggregates and asphalt binder. The respondent provided the following reason why this could be happening:

> *Supply and demand, spikes in work load, reduced number of suppliers of materials, permitting issues. Availability of aggregate resources is an acute problem in some parts of the state, and growing worse. Oil (and asphalt binder) availability has also been an issue due to industry consolidation.*

Question 21 – Was there ever a time in recent years (i.e., 2013 to 2016) that you are aware of when your members would have experienced similar difficulties ordering construction materials?

Only one respondent said that members have experienced difficulties ordering materials in recent years. The respondent said that there was a shortage of "aggregates, asphalt binders. There was a shortage of a specialized lane striping material for a time due to industry consolidation." The respondent attributed these shortages to market forces as well as the difficulty of finding qualified workers. The respondent stated the following:

> *Sometimes market forces contribute to shortages of materials. However, some problems, such as finding qualified workers and adequate aggregate resources, are chronic and getting worse.*

3.4 Section D – Materials Suppliers/Manufacturers

Section D of the questionnaire asked respondents to provide details regarding any struggles their members have experienced when supplying their customers with construction materials since 2018, and how this situation compares to recent years (i.e., 2013 to 2016).

Question 22 – Does your association support materials suppliers and/or manufacturers?

Five respondents said that their associations represent material suppliers, while three did not.

Question 23 – Have your members experienced difficulties supplying their customers with construction materials/products since 2018?

Two respondents said that their members have experienced difficulties. One respondent said that their members have not experienced any trouble supplying materials to their customers, while two other respondents were unsure. The materials that members experienced difficulties supplying since 2018 were aggregates, asphalt binder, and concrete. One respondent said that their members have struggled to supply materials since 2018, not due to a shortage of materials, but rather not having enough truck drivers. Another respondent said that the issue arises from the market forces and industry consolidation as well as permitting, unreasonable regulations, and other bureaucratic impediments. Table 7 lists all the comments regarding the reasons why members experienced difficulties supplying materials since 2018.

Table 7. Reasons Why Members Experienced Difficulties Supplying Materials since 2018

Question		Comments
Q23 Part A	**If *a* in Q23, please elaborate; we are looking for reasons as to why you think this could be happening.**	Some is related to market forces and industry consolidation. Others are related to uneven distribution of public sector projects. Permitting, unreasonable regulations and other bureaucratic impediments are delaying the efficient acquisition and availability of some construction materials.
		To some extent there are difficulties due to not having enough drivers or truckers to deliver materials. The material itself is not in short supply, only the ability to deliver it on time.

Question 24 – Was there ever a time in recent years (i.e., 2013 to 2016) that you are aware of when your members would have experienced similar difficulties supplying construction materials/products?

Only one respondent said that their members experienced similar difficulties supplying aggregates and asphalt binder. This respondent said that "shortages and price spikes happened periodically in the past, but they are becoming more chronic now." One respondent said that, in recent years, their members have not experience any struggles

supplying materials. The respondent stated that, “in general, the economy and unemployment in the immediate post years of the great recession had not quite reached the point they have now.”

Question 25 – Have your members indicated that their overall unit prices will change next year, and if so by what percentage (approximately)?

Three respondents said that their members are planning to increase their overall unit prices in the next year. The percentage increase provided by these respondents was in the 2 to 5% range. Two respondents said that they were unsure.

Question 26 – For the price changes you’ve indicated, how much of the changes can be attributed to SB 1?

One respondent said that some of the price changes their members will experience next year can be attributed to SB 1, and that this increase “is a very rough estimate as we have a diverse membership.” Another respondent said that none of the changes can be attributed to SB 1, while one respondent was unsure.

3.5 Section E – Trucking Firms

Section E of the questionnaire asked respondents to provide details regarding the any struggles their members have experienced when transporting their customers’ materials since 2018, and how this situation compares to recent years (2013 to 2016).

Question 27 – Does your association support trucking firms?

Three respondents said that their associations supported trucking firms, while the other five associations did not.

Question 28 – Have your members been able to meet demand for trucking and freight services since 2018 from the construction industry or those industries which supply materials used in the construction of transportation and infrastructure projects?

Two respondents said that their members have been able to meet the demand for trucking and freight services since 2018 from the construction industry, while one other respondent was unsure. However, one respondent said that the shortage of truck drivers has become an increasing challenge in the industry due to employment law and regulations.

> *Trucking has become an increasing challenge in the construction industry, particularly with recent court rulings related to employment law, and regulations covering truck emissions.*

Question 29 – Was there ever a time in recent years (i.e., 2013 to 2016) that you are aware of when your members would have experienced similar difficulties meeting trucking and freight demand from the construction industry?

None of the three respondents said that there was ever a time in recent years (2013 to 2016) when their members would have experienced similar difficulties meeting trucking and freight demand from the construction industry.

Question 30 – Have your members indicated that their shipping costs will change next year, and, if so, by what percentage (approximately)?

Two respondents said that they are unsure whether their members will change their shipping costs next year. One respondent said that their members will increase their shipping cost next year by 4%. This respondent noted that "this is a very rough estimate based on small sample size."

Question 31 – For the shipping cost changes you've indicated, how much of the changes can be attributed to SB 1?

One respondent said that their members will increase their shipping costs, and this respondent attributed some of this increase to SB 1.

3.6 Final Thoughts or Comments

Table 8 lists all of the final thoughts and comments provided by the responding associations as part of Question 32.

Table 8. Final Thoughts or Comments

Question		Comments
Q32	**Do you have any final thoughts or comments you would like to share about how SB 1 funding could impact the construction industry in California?**	We need more funding from SB 1 on the North Coast. The rural areas need more funding bottom line.
		More funding means more jobs which is good for the economy.
		We need roads fixed and lanes added everywhere. Investment in infrastructure always boosts the economy.
		Speedy delivery of road repair projects is the best way to build confidence on the part of the public that dollars generated from the "Road Repair & Accountability Act of 2017" are being used in the matter in which they were intended. Delivering pavement improvement projects quickly and in every part of the state will be the most visible way for this to be demonstrated. Delaying projects, or delivering mega-projects at the expense of smaller projects in more areas, will blunt the impact of SB 1.
		It is unfortunately taking longer to design, approve, bid, award, and start construction projects. This has diluted some of the positive impact SB 1 could have had on construction and road improvements.

4 Summary of Findings and Conclusions

This section synthesizes the survey results to identify trends and possible effects of SB 1 on the construction industry.

4.1 Key Findings by Questionnaire Section

4.1.1 Association

- All eight of the respondents said that their associations were familiar or somewhat familiar with SB 1.

4.1.2 Members

- The number of association members provided by respondents ranged from 75 to 70,000. The median number of members was 876 members, while the average was 15,001 members.
- When asked about their members' construction outlook over the next five years, all respondents responded in the positive by seeing either an increase in business or holding course. None of the respondents said that their members believe there will be a downturn in business. Five of the respondents attributed some to all of the positive growth changes to SB 1.
- Three respondents said that their members have experienced difficulties finding employees with the right skill sets since 2018. Three other respondents said that their members did not experience difficulties finding the right skills. One respondent was unsure whether their members experienced such difficulties.
- Two respondents said that it is more difficult now to find the right skill sets compared to recent years. Another three respondents said that the experience has been similar to what has been observed in recent years. One respondent said that the process of finding the right skill set is evolving.
- The majority of non-union respondents said that their members have had to increase their wages since 2018 in order to attract the right talent and labor.
- Non-union associations said that their members expect overall wages in the industry to increase next year. The respondents attributed some of these wage increases to SB 1.

4.1.3 Construction Firms and Construction Workers

- Seven respondents said that their associations support construction firms or construction workers.
- The respondents had varying opinions about whether their members experienced difficulties or longer wait times when ordering construction materials since 2018. One respondent said that their members experienced difficulties, two said that their members did not have any difficulties, and four were unsure.

4.1.4 Materials Suppliers and Manufacturers

- Five of the eight responding associations support materials suppliers and manufacturers.
- Two respondents said that their members have experienced difficulties supplying their customers with construction materials since 2018. These respondents said that their members struggle to supply aggregates, asphalt binder, and concrete.
- Three respondents said that their members plan to increase their overall unit prices in the next year. The percentage increase provided by these associations was in the 2% to 5% range. One respondent attributed some of this price change to SB 1.

4.1.5 Trucking Firms

- Respondents from the three associations that represent trucking firms shared differing viewpoints as to whether their members had difficulties meeting the demand for trucking or freight services since 2018. Two respondents said that their members had not experienced difficulties, while the other one was unsure.
- One respondent said that their members will increase their shipping costs (in this case, by 4%), and that some of the shipping cost increase could be attributed to SB 1. The other two respondents were unsure.

4.2 Emerging Conclusions

The responses from the eight associations that participated in the survey provide insights as to possible market effects on the construction industry and how construction firms and construction workers, material suppliers and manufacturers, and trucking firms view recent changes in the construction market. Some of these associations represent hundreds or thousands of members and have a pulse on how the construction market is changing under increasing demand from SB 1 funded projects.

On the whole, the respondents said that their associations' members are starting to see some of the effects of SB 1. These respondents also noted that factors other than SB 1 shaped the changes they have seen and expect to see in the future. Most of respondents said that their members have a positive or status-quo outlook regarding the construction industry over the next five years and that some to all of these changes can be attributed to SB 1. The respondents said that SB 1 will create local jobs with secure cash inflow, and that the extra funding will help reduce the backlog of infrastructure projects.

Finding the right construction labor skill set has posed difficulties for some of the associations' members. Respondents from non-union associations said that their members had to increase wages since 2018 in order to attract qualified staff and that some of increase could be attributed to SB 1. One respondent said that "the construction industry in general has had a difficult time recruiting and retaining workers, particularly at the craft level." The respondents noted that low unemployment and a competitive market could be factors driving the shortage of skilled workers.

The respondents from the four associations that did not observe hiring challenges for their members and attributed the ability to finding the right skill set to their members' apprenticeship programs. A remark from one respondent highlights a different issue with

the hiring process: “I would say it is evolving as more millennials look to go into construction. They value their time over financial success.” Industry will need to think of different strategies to attract younger people to the lucrative trades.

The respondents with the responding associations understood the economic benefits of SB 1 based on their comments throughout the questionnaire, even with some of the challenges that the increase in infrastructure funding would create in an already competitive landscape. They could not on the whole attribute changes in skills availability, wages, and materials prices to SB 1. They highlighted areas in California and types of road improvement projects that need attention sooner than later. By assessing the final comments provided by the associations, HDR concluded that by speeding up the delivery of SB 1 projects, a stronger positive effect on California’s transportation system can be felt.

Appendix A. Industry and Trade Associations Questionnaire

SB 1 Impact on Construction Cost Survey

Survey length: 8 minutes

HDR Inc., an engineering consulting firm, is conducting a survey to help Caltrans understand how increased infrastructure funding from Senate Bill 1 (SB 1) will impact future highway and bridge construction costs. SB 1 invests $5.4 billion annually through 2027 to fix California's transportation system. It will address a backlog of repairs and upgrades, while ensuring a cleaner and more sustainable travel network for the future.

Your input as trade and industry association leaders will provide much needed insight on the market of construction firms, employees and materials that help Caltrans improve transportation in California.

The survey takes about 8 minutes or less, and is entirely confidential. Your survey responses will be analyzed only after all personal identifying information is removed. Survey responses will be aggregated and not be identified in the final results. Your input will be used only for this analysis.

Please complete your questionnaire by August 25, 2019. If you have any questions about this study, please don't hesitate to call May Raad at 1-877-687-4634/email at may.raad@hdrinc.com, or you can email Mr. Joseph Dongo of Caltrans at Innovative.delivery@dot.ca.gov.

Section A: Your Association

If you are able, please provide information about where you work to help us categorize the data.

1. Association name:
2. Job Title:
3. Email contact address:
4. City/Town:
5. Are you familiar with infrastructure funding through California's Senate Bill 1 (SB 1) investments?
    a. Yes
    b. Somewhat familiar
    c. No

Section B: Your Members

6. How many association members do you have? If you don't know the exact number, an estimate is helpful.
   Answer ____

7. What is the general view of your members regarding the construction outlook over the next five years?
    a. Growth in business
    b. Downturn in business
    c. Similar to what has been observed in past 5 years
    d. Unsure

8. *If a in Q8, ASK:* Please explain why you think your members are viewing a growth in business over the next five years? **[Open End]**

9. *If b in Q8, ASK:* Please explain why you think your members are viewing a downturn in business over the next five years? **[Open End]**

10. *If c in Q8, ASK:* Please explain why you think your members see a similar construction outlook to what has been observed in the last 5 years? **[Open End]**

11. *If d in Q8, ASK:* Please explain why you think your members are unsure about their expectations for business growth over the next five years? **[Open End]**

12. *If a,b, in Q5, a,b,c in Q8, ASK:* Based on what you have observed regarding your members' views on business growth over the next five years, how much of their expectations can be attributed to SB 1?
    a. None
    b. Some
    c. Most
    d. All
    e. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**

13. Have your members experienced difficulties finding the right skill set since 2018?
    a. Yes, please elaborate, we are looking for reasons as to why you think this could be happening **[Open End]**
        i. What types of skills were in short supply? **[Open End]**
    b. No, please elaborate, we are looking for reasons as to why you think it is not an issue **[Open End]**
    c. Don't know

14. How does finding the right skill set compare to recent years (i.e., 2013 to 2016)? **[Open End]**

15. Is your association a union?
    a. Yes
    b. No

16. *If b in Q15, ASK:* Have your members had to increase wages since 2018 in order to attract the right talent and labor?
    a. Yes, please elaborate, we are looking for reasons as to why you think this could be happening **[Open End]**
        i. What types of skills had wage increases? **[Open End]**
    b. No, please elaborate, we are looking for reasons as to why you think it is not an issue **[Open End]**
    c. Don't' know

17. *If b in Q15, ASK*: Have your members indicated that their overall wages for their industry will change next year, and if so by what percentage (approximately)? Please select one.
    a. No Change
    b. Increase of _____ percent
    c. Decrease of _____ percent
    d. Don't know

18. *If a,b in Q5, b in Q15, and b,c in Q17 Ask*: For the wage changes you've indicated, how much of the changes can be attributed to SB 1?
    a. None
    b. Some
    c. Most
    d. All
    e. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**

Section C: Construction Firms/Construction Workers

19. Does your association support construction firms and/or construction workers?
    a. Yes
    b. No

20. *If a in Q19, ASK:* Have your members experienced difficulties or longer wait times when ordering construction materials since 2018?
    a. Yes, please elaborate, we are looking for reasons as to why you think this could be happening **[Open End]**
        i. Which materials were in short supply? **[Open End]**
    b. No, please elaborate, we are looking for reasons as to why you think it is not an issue **[Open End]**
    c. Don't know

21. *If a in Q19 and a in Q20, ASK:* Was there ever a time in recent years (i.e., 2013 to 2016) that you are aware of when your members would have experienced similar difficulties ordering construction materials?
    a. Yes, please elaborate, We are looking for reasons as to why you think this would have been happening **[Open End]**
        i. Which materials were in short supply? **[Open End]**
    b. No, please elaborate, We are looking for reasons as to why you think was not an issue **[Open End]**
    c. Don't know

Section D: Materials Suppliers/Manufacturers

22. Does your association support materials suppliers and/or manufacturers?
    a. Yes
    b. No

23. *If a in Q22, ASK:* Have your members experienced difficulties supplying their customers with construction materials/products since 2018?
    a. Yes, please elaborate, we are looking for reasons as to why you think this could be happening **[Open End]**
        i. Which materials/products were in short supply? **[Open End]**
    b. No, please elaborate, we are looking for reasons as to why you think it is not an issue **[Open End]**
    c. Don't know

24. *If a in Q22 and a in Q23, ASK:* Was there ever a time in recent years (i.e., 2013 to 2016) that you are aware of when your members would have experienced similar difficulties supplying construction materials/products?
    a. Yes, please elaborate, we are looking for reasons as to why you think this would have been happening **[Open End]**
        i. Which materials/products were in short supply? **[Open End]**
    b. No, please elaborate, we are looking for reasons as to why you think it was not an issue **[Open End]**

25. *If a in Q22, ASK:* Have your members indicated that their overall unit prices will change next year, and if so by what percentage (approximately)? Please select one.
    a. No Change
    b. Increase of _____ percent
    c. Decrease of _____ percent
    d. Don't know

26. *If a in Q22, and b,c in Q25, ASK:* For the price changes you've indicated, how much of the changes can be attributed to SB 1?
    a. None
    b. Some
    c. Most
    d. All
    e. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**

Section E: Trucking Firms

27. Does your association support trucking firms?
    a. Yes
    b. No
28. *If a in Q27, ASK:* Have your members been able to meet demand for trucking and freight services since 2018 from the construction industry or those industries which supply materials used in the construction of transportation and infrastructure projects?
    a. Yes, please elaborate, we are looking as to why you think your members were able to meet demand **[Open End]**
    b. No, please elaborate, we are looking for reasons as to why you think your members were not able to meet demand **[Open End]**
    c. Don't know

29. *If a in Q27 and b in Q28, ASK:* Was there ever a time in recent years (i.e., 2013-2016) that you are aware of when your members would have experienced similar difficulties meeting trucking and freight demand from the construction industry?
    a. Yes, please elaborate, We are looking for reasons as to why you think this would have been happening **[Open End]**
    b. No, please elaborate, We are looking for reasons as to why you think it was not an issue **[Open End]**

30. *If a in Q27, ASK:* Have your members indicated that their shipping costs will change next year, and if so by what percentage (approximately)? Please select one.
    a. No Change
    b. Increase of _____ percent
    c. Decrease of _____ percent
    d. Don't know

31. *If a in Q27, and b,c in Q30, ASK:* For the shipping cost changes you've indicated, how much of the changes can be attributed to SB 1?
    a. None
    b. Some
    c. Most
    d. All
    e. Don't know

    If you would like, please feel free to elaborate on your response. **[Open End]**
32. Do you have any final thoughts or comments you would like to share about how SB 1 Funding could impact the construction industry in California? **[Open End]**

That completes our survey. Thank you for your time.

Appendix E

Focus Group Analysis Report

Executive Summary

Over July and August 2019, HDR conducted an online survey that invited various stakeholders—construction contractors, material producers and suppliers, and industry associations who have been involved in highway or bridge construction projects for Caltrans—to share their insights related to changes in labor availability, construction wages, and prices for materials since SB 1 was implemented in 2017. As a follow-up to those surveys, HDR invited past survey participants to attend a focus group session that explored the capacity of contractors, material suppliers, and material producers to bid on and deliver construction services as SB 1 funding ramps up to $5.4 billion per year.

HDR was able to recruit five stakeholders to participate in the discussions. A focus group session took place on November 11, 2019, with four participants. A one-on-one session occurred on November 13, 2019 with one person who was available on that day only. Each session lasted about 1½ hours.

Key Findings

HDR's qualitative analysis revealed four overarching themes across the participants' feedback with related subthemes. The findings underscored that, as of November 2019, the construction industry in California has not seen the influx of projects from SB 1 and the industry has capacity if the planned SB 1 projects become available. The four key findings are:

1. The industry has the capacity to deliver.
2. Complicated specifications, regulations, and other bureaucratic impediments are affecting the attractiveness of SB 1 funded projects.
3. If the number of projects surpasses the number of projects the industry saw during the peak period of 2004 to 2007, bidders would start thinking about reaching capacity.
4. Participants are concerned about Caltrans' capability to issue projects.

Contents

Appendices

Acronyms and Abbreviations

Caltrans	California Department of Transportation
CEO	Chief Executive Officer
SB	Senate Bill

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1 Introduction

HDR has been working with the California Department of Transportation (Caltrans or the Department) to study how increased infrastructure funding from Senate Bill 1 (SB 1) could affect future highway and bridge construction costs. The goal of SB 1 is to address a backlog of repairs and upgrades to the transportation system while ensuring a cleaner and more sustainable travel network for the future. The funding program will do so through investing $5.4 billion annually to repair California's transportation system.

Over July and August 2019, HDR conducted an online survey that invited various stakeholders—construction contractors, material producers and suppliers, and industry associations who have been involved in highway or bridge construction projects for Caltrans—to share their insights related to changes in labor availability, construction wages, and prices for materials since SB 1 was implemented in 2017. As a follow-up to those surveys, HDR invited past survey participants to attend a focus group session that explored the capacity of contractors, material suppliers, and material producers to bid on and deliver construction services as SB 1 funding ramps up.

The remainder of this report is divided into the following sections:

- *Section 2 – Methodology* explains the approach that HDR used to select the focus group participants and moderate the sessions.
- *Section 3 – Key Findings* identifies the key takeaways from the focus group discussions. The key findings are organized into themes.
- *Section 4 – Other Concerns* summarizes additional concerns regarding the construction industry in California.
- *Section 5 – Conclusion* presents the conclusions drawn from the focus group findings.

2 Methodology

This section explains the approach that HDR used to select the focus group participants and moderate the focus group sessions.

2.1 Participants and Procedure

All respondents who attempted to complete (fully or partially) the SB 1 Impact on Construction Cost Escalation Surveys were invited to participate in the focus group. A focus group session was planned on November 11, 2019, with four participants. A one-on-one session was planned on November 13, 2019 with one person who was available on that day only. Each session lasted about 1½ hours.

At the beginning of the sessions, HDR informed participants that the sessions would not be taped and that HDR would take written notes of the discussions. In addition, HDR told participants that if they were uncomfortable answering any question, they could recuse themselves. At the end of the sessions, the participants agreed to share their names in this report.

The following members of the construction industry participated in the focus group sessions and provided their insights regarding past and current construction market conditions in California. These participants comprise two members of associations, one construction contractor, one materials supplier, and one product manufacturer.

- **Kurt Clink, President and Chief Executive Officer (CEO) of Truesdell Corporation.** Truesdell Corporation works in 40 states and specializes in repair and maintenance work on bridges.
- **Edgard Hitti, National Asphalt Manager for Granite Construction.** Edgard has been involved in a several committees over the years with Caltrans.
- **Charley Rea, Director of Communication and Policies for California Construction and Industrial Materials Associations (CalCIMA).** Charley has been involved in activities supporting SB 1 in the past and defending it more recently.
- **Russell Snyder, Executive Director of the California Asphalt Pavement Association (CalAPA).** Russell is an advocator for steady and sustainable sources of funding needed to repair the roads in California.
- **Bill Stalberger, CEO of Surfa Slick.** Surfa Slick manufactures magnesium asphalt lutes used for smoothing asphalt pavement.

2.2 Facilitators

HDR facilitated the focus groups using open-ended interviews. The interview questions (see Appendix A) were developed by HDR to gauge the level of readiness and capacity the construction industry has to bid and work on the incremental increase in project awards resulting from SB 1. The feedback from the participants also served as a way to corroborate some of the key trends collected from the SB 1 Impact on Construction Cost Escalation Surveys. Particularly, the focus group sessions helped answer a question about when bidders in the industry would reach their capacity to bid on projects.

3 Key Findings

HDR's qualitative analysis revealed four overarching themes across the participants' feedback with related subthemes. The findings underscored that, as of November 2019, the construction industry in California has not seen the influx of projects from SB 1 and the industry has capacity if the planned SB 1 projects become available. The four key findings are:

5. The industry has the capacity to deliver.
6. Complicated specifications, regulations, and other bureaucratic impediments are affecting the attractiveness of SB 1 funded projects.
7. If the number of projects surpasses the number of projects the industry saw during the peak period of 2004 to 2007, bidders would start thinking about reaching capacity.
8. Participants are concerned about Caltrans' capability to issue projects.

1: The industry has the capacity to deliver

Focus group participants provided their input about how construction firms and suppliers are currently planning for business growth in the future. The consensus was that construction firms and suppliers are planning a minimum of 6 months to a year out and that they currently have the capacity to bid on more projects in their plans. The sentiment that the industry has the capacity to work was significant. Several participants spoke about how their organizations continue to grow and have more than enough capacity to bid on projects as they are let out.

> *"As far as capacity is concerned, there is plenty. We have the capacity and need more projects."*

A member of the construction industry stated:

> *"We can do a lot more than what is currently out in the market."*

Participants reported that the number of projects is nowhere near 2004–2007 levels, and that the industry has the capacity for more work. One participant stated:

> *"I heard everyone saying they are not back to pre-recession capacities and are more than ready for a large increase in projects coming to the market."*

One participant noted that if his firm has a sense that there is a high number of bidders on a project and that they are already near capacity, they would still bid, but bid high.

2: Complicated specifications, regulations, and other bureaucratic impediments are affecting the attractiveness of SB 1 funded projects

Participants said that Caltrans' projects have a bigger risk due their complicated specifications, regulations, and other bureaucratic impediments. A participant also stated that Caltrans is one of the only agencies where there are issues with paying bills. This issue, among others, causes frustrations among firms and if there are opportunities to go elsewhere, firms will do that. These bureaucratic impediments work against the Department. A number of participants said that private projects involve less risk, and that the market will move to the path of less resistance.

> *"Contractors will go to the path of less resistance and more profit. If a private project offers bigger profits, contractors will move to those projects."*

Another participant stated:

> *"Caltrans' process is too complicated, and there are Cities and Counties that are easier to work with. Contractors will bid on these projects first.""*

One participant pointed out that another factor affecting the attractiveness of Caltrans projects is their inflexible schedules. This participant said:

> *"We have nothing to gain if a job takes longer. The motivation is to get it done as soon as possible. However, Caltrans' schedule doesn't allow for flexibility, which means that contractors have to pass on projects."*

A common sentiment shared by all of the participants is that they hope Caltrans can streamline the process and make it as straightforward as possible.

> *"I hope that the process will be more simple, straightforward, and less bureaucratic. There is a need for clear information and guidelines."*

Even with these difficulties, many participants said that Caltrans is one of their biggest clients, and that they have learned how to navigate bureaucracy.

> *"Caltrans is still one of the most attractive projects. We have learned to deal with Caltrans."*

3: If the number of projects surpasses the number of projects the industry saw during the peak period of 2004 to 2007, bidders would start thinking about reaching capacity

The participants were asked to estimate the point at which they would reach their capacity to bid. Many participants were not able to provide an estimate. However, they stated that the number of Caltrans projects they are seeing are nowhere near top of the market in 2004–2007. They are not worried about capacity at this stage. However, if the number of let projects starts to reach the numbers seen during the last pre-recession era, the participants said that they would be concerned about their capacity.

One participant estimated that he would not be nervous if there were a two-fold increase in the number of projects compared to what he has currently seen. He would start getting nervous if he saw a three-fold increase.

4: Participants are concerned about Caltrans' capability to issue projects

Participants raised concerns about Caltrans' ability to let projects. One participant stated:

> *"The potential growth with SB 1 money is yet to be seen. Caltrans is struggling to hire and to put projects out. These factors could create a potential bottleneck."*

Another participant stated:

> *"A valid question for this analysis would be whether Caltrans can convert SB 1 funds into projects."*

A concern expressed by participants is how Caltrans is planning to let the extra funds. Would it be an increase in the number of projects or an increase in the amount each project is worth?

> *"If Caltrans doubles the project amount, this will create megaprojects. Only a few big companies would be able to bid on them; these megaprojects would restrict the pool of bidders. If Caltrans doubles the number of projects, this would create a more diverse pool of bidders and would allow smaller companies to bid."*

Another participant added:

> *"If megaprojects are divided in[to] multiple smaller projects, this would raise the cost of the project (sharing overhead over multiple companies). But if they are not divided, this would constrict the pool of bidders. There is a balance between megaprojects and smaller projects that Caltrans need[s] to reach."*

4 Other Concerns

The participants expressed the following other concerns regarding the construction industry in California:

- **Industry consolidation:** One participant said that "the continuing trend will have an impact on the number bidders, and how projects are delivered over time."
- **Availability of fly-ash:** "One of the sources in the state of California is closing down. There may be a shortage of fly-ash in the future, as coal plants keep closing down. Fly-ash producers will give priority to Caltrans projects, since they are [a] big client."
- **Regulation regarding asphalt production:** One participant said that new regulations are making the production of asphalt more difficult.
- **Concern regarding truck drivers:** Participants were concerned about the lack of truck drivers. One participant said that California Assembly Bill 5 (AB 5), which will go into effect on January 1, 2020, will affect independent truck drivers. AB 5 is intended to protect workers employed in the so-called "gig"[1] economy, such as with ridesharing companies Uber and Lyft. The bill addresses the misclassification of drivers as independent contractors rather than employees. However, the bill will make the hiring of independent truck drivers extremely difficult for firms and trucking companies due to the new classification of independent drivers. The bill will interrupt the long-standing, good working relationship between trucking companies and independent truck drivers.

[1] The "gig" economy is defined as a labor market characterized by the prevalence of short-term contracts or freelance work as opposed to permanent jobs.

5 Conclusion

The focus group sessions conducted by HDR revealed how participants viewed SB 1 as of November 2019, two years after SB 1 became law. Although these participants were not representative of all construction trade or industry associations, construction contractors, and material suppliers and producers that work on or supply Caltrans projects, the opinions HDR obtained provide further insights regarding the effects of SB 1 on the construction industry in California.

Overall, the two focus group sessions were well-received by the participants. Several participants said that they have the capacity to work and are ready for the challenge. These findings validate the key summary points from the surveys completed by construction contractors, materials suppliers and producers, and associations. In these surveys, the respondents noted only a minor impact from SB 1 on the numbers of let and awarded projects, wages, and materials prices. Many of the focus group participants said that they have not seen the expected influx of projects since SB 1 was introduced, and are concerned with Caltrans' capability to convert these funds into projects.

Appendix A. Focus Group Questions

Questions

Question 1: How are construction firms and suppliers currently planning for business growth in the future?

Question 2: Thinking about the increase in funds for construction projects over the last year, how would a doubling or tripling of the increase affect the capacity to bid or supply?

Question 3: By what percent would the funding levels need to increase before you would reach capacity to bid on highway/bridge construction projects?

Question 4: Are there geographic disparities in materials availability that could affect pricing on a geographic basis?

Question 5: What other construction activities or markets in California could compete with Caltrans in attracting bidders?

Closing discussion and final comments.

Appendix F

Annotated Literature Review

#	LITERATURE	STUDY DESCRIPTION	KEY STUDY INFORMATION	URL/DOI	DATE ACCESSED
Contractor Competition: Does the contracting industry in California have the capacity to bid and bond the volume of work anticipated over the next 10 years?					
1	Eaton, C. (April 17, 2019). FMI Report: Merger and Acquisition Activity Still Strong in 2019, But Last Year was Exceptional, Associated General Contractors of California.	The article shows that the engineering and construction market sector saw a record level of merger and acquisition (M&A) activity since 2018. The M&A in the industry is likely to remain strong, but it also likely that it will return to more historic levels.	The article highlights the following key finding from the FMI report: - More than 75 % of all survey respondent believe that the industry valuations have risen over the past 2 years. The primary reason been the increase market activity and improved performance of target companies. - A total of 61 % of survey respondents indicated that one of their competitor had been acquired in the last 3 years. - A number of 66 % of the respondents stated that at least one of their competitors had made an acquisition in the past three years. - 46 % of the respondents stated that they had consider acquiring a technological solution or commercializing an in house technology solution.	https://www.agc-ca.org/News-Press/News-Forms/FMI-Report--Merger-and-Acquisition-Activity-Still-Strong-in-2019/	8-Dec-19
2	Fails Management Institute, (2019). FMI's 2019 M&A Trends for Engineering and Construction.	FMI studies the trends of mergers and acquisitions (M&A) in 2018 for the engineering and construction (E&C) industry. FMI noted that the demographic succession needs in the industry coupled with high buyer interest are creating an environment conducive to M&A activity in the E&C industry.	Fails Management Institute saw a record level of deals in 2018. After the Great Recession, M&A activity in the E&C industry was relatively steady from 2010 to 2017, tracking between 390 to 440 deals annually. In 2018 alone, 534 transactions were announced in the E&C industry, which represents a 26.5% increase over the previous year.	https://www.fminet.com/wp-content/uploads/2019/04/FMI_MA_Study_2019.pdf	8-Dec-19
3	Gil, R. & Marion, J. (April 2013). Self-Enforcing Agreements and Relational Contracting: Evidence from California Highway Procurement. The Journal of Law, Economics, and Organization, 29(2), pp. 239-277.	This study examines the impact of relationships (informal self-enforcing contracts) between contractors and subcontractors on firm pricing and entry decisions in the California highway procurement market. It shows that these relationships are valuable if they mitigate potential hold-up problems and incentives for ex post renegotiation due to contractual incompleteness. Specific productivity is the measure of the future value of ongoing relationships. The findings show that a larger stock of relationships leads to a greater likelihood of entry and lower bids.	Relational contracting between firms and suppliers supports implicit contracts that obtain first-best outcomes not otherwise achievable through formal contracts. Bidding on California highway auctions is used as an example to demonstrate how, though Caltrans attempts ex ante to specify relevant work details, unforeseen contingencies that arise after the project award lead to costly renegotiations. The data used in the study include the universe of 5120 road construction and repair contracts put up for bid by Caltrans between May 1996 and October 2005. Observations are 26,125 bids by 1735 firms, of which 805 win at least one contract. The median engineer's estimate for a project is $620,000. The study uses a regression model to show that the future value of relationships can be quantified using the arrival rate of projects. This measure is orthogonal to contractor-subcontractor productivity and influences bidding behavior.	https://doi.org/10.1093/jleo/ewr026	27-Jun-19
4	Gross, A., & Marcus, J. (April 25, 2018). High-Paying Trade Jobs Sit Empty, While High School Grads Line Up For University. National Public Radio.	This article analyses the issue of high school students focusing on getting a bachelor's degree while overlooking trade jobs. The article highlights how 70% of construction companies nationwide are having trouble finding qualifies workers. These shortages of workers are pushing wages higher in the skilled trades.	The article looks at how the shortage of workers in the trade industry is driving wagers up. A major factor driving this shortage is the lack of interest of high school students to get a trade education. High school students have been effectively motivated to get a bachelor's that high-paying jobs requiring shorter and less expensive training are been overlooked and unfilled. The articles stated that according to the Bureau of Labor Statistics; construction, health care, and personal care will account for one-third of all new jobs through 2022. Many states are starting to pay attention to this issue, for example, the state of California is spending $200 million to improve their delivery of career and technical education.	https://www.npr.org/sections/ed/2018/04/25/605092520/high-paying-trade-jobs-sit-empty-while-high-school-grads-line-up-for-university.	12-Dec-19

#	LITERATURE	STUDY DESCRIPTION	KEY STUDY INFORMATION	URL/DOI	DATE ACCESSED
5	Larsen, J. K., Shen, G.Q., Lindhard, S.M., Brunoe, T.D. (2016). Factors Affecting Schedule Delay, Cost Overrun, and Quality Level in Public Construction Projects, Journal of Management in Engineering, 32(1): 04015032.	This study analyzes the factors that have the greatest impact on the time, cost, and quality of public construction projects, as experienced by project managers.	Lack of project funding was found to have the greatest impact on time for construction projects, which could thus be positively impacted by SB 1. Errors, omissions, or inconsistencies in consultant material, project documents, and construction work impact cost and quality most heavily. Additionally, inexperienced or newly qualified consultants also impact cost and quality of construction projects, implying that a shortage of qualified and skilled workers in the construction and engineering industry would also impact the capacity of contractors to deliver projects efficiently.	https://pdfs.semanticscholar.org/2089/91c320785a0ff3769452c20232ff848b7be3.pdf	9-Aug-19
6	McLoud, D. (November 7, 2018). Heavy equipment supply-chain tightness likely through 2019, thanks to higher demand. Equipment World.	This article reviews the increasing demand for manufactured components for construction equipment over recent years and the impact of related economic factors on heavy construction contractors.	The skilled labor shortage in the equipment manufacturing industry, coupled with rising demand for construction equipment, leads to "longer wait times for finished products". Additionally, high tariffs for imported commodities for construction equipment, such as aluminum and steel from China, provides an incentive to source domestic commodities and contributes to longer lead times and higher costs. Finally, "longer freight delivery [due to] a shortage of truckers" further impedes supply chains of materials and heavy construction equipment, posing challenges to the U.S. construction industry in meeting the growing demand for construction services.	https://www.equipmentworld.com/heavy-equipment-supply-chain-tightness-likely-through-2019-thanks-to-higher-demand/	9-Aug-19
7	Slowey, K. (2018, May 22). Construction M&A activity continued to expand in 2017. Construction Dive, www.constructiondive.com	The article summarizes the key findings from the FMI Capital Advisors' 2018 Merge and Acquisition (M&A) Trends for Engineers and Construction. The report concluded that in 2017 the market for industry mergers and acquisitions was robust. The articles discuss which factors are driving M&A activity.	The article includes factors that are driving the robust M&A observed in 2017. These factors include more opportunities to expand into alternative delivery methods and attractive regional market, an inclination to increase capacity through vertical integration, and better financing options for publicly held company deals, among other factors. Some strategically driven M&As involve the union of design firms and construction firms looking to vertically integrate to expand deliveries capabilities.	https://www.constructiondive.com/news/construction-ma-activity-continued-to-expand-in-2017/523973/	8-Dec-19
8	Sweis, G., Sweis, R. J., Bisharat, S. M., & Bisharart, L. (2014). Factors Affecting Contractor Performance on Public Construction Projects, Life Science Journal, 11(4s), pp. 28-39.	This study examines the factors that impact the performance of contractors, consultants, and owners, insofar as this performance impacts the various aspects of public construction projects. Data was collected from a survey delivered to consultants, contractors and owners. This was supplemented with interviews with managers and other senior professionals in the field.	Contractors' financial difficulties were agreed upon as one of the most critical factors impacting contractor performance on public construction projects, according to consultants, owners, and contractors alike.	https://www.researchgate.net/publication/264587513_Factors_Affecting_Contractor_Performance_on_Public_Construction_Projects/link/54f215790cf2f9e34eff7f34/download	9-Aug-19

#	LITERATURE	STUDY DESCRIPTION	KEY STUDY INFORMATION	URL/DOI	DATE ACCESSED
Contractor Competition: How can Caltrans best bundle (i.e. size) its project to maximize the number of bidders on its projects?					
9	Ballesteros-Pérez, P., Skitmore, M., Pellicer, E., & Gutiérrez-Bahamondes, J. H. (2016). Improving the estimation of probability of bidder participation in procurement auctions. International Journal of Project Management, 34(2), 158–172	This paper develops a method for estimating every potential bidder's probability of participating in a future auction as a function of the tender economic size (or budget), thus removing the bias caused by the contract size opportunities distribution.	Anticipating the number and identity of bidders has a significant influence on many theoretical results of the auction itself and bidders' bidding behavior. This is because when a bidder knows in advance which specific bidders are likely competitors, this knowledge gives the company a head start when setting the bid price. The authors create a biased participation ratio based on the proportion of all auctions in the available dataset in which a given bidder is willing to participate. This bias is accounted for through a log-normal contract size opportunities distribution, or the preferences of a bidder to submit a bid on a project based on its contract size. This methodology yields a model for unbiased participation ratios to predict the bidding behavior of each bidder based on historical data. Bidding data from 47 Hong Kong construction contracts were used as a case study to demonstrate the efficacy of this model.	https://doi.org/10.1016/j.ijproman.2015.1.001	6-Aug-19
10	Drew, D. & Skitmore, M. (1997). The effect of contract type and size on competitiveness in bidding, Construction Management and Economics, 15(5), pp. 469-489.	This study uses a multiple regression model to relate bidder competitiveness to the bidder type, contract type, and contract size. The most competitive contractors appear to be those with a preferred contract size range. These findings can be used as part of a systemic approach in prequalifying contractors or as a basis for assessing bidding performance.	Competitiveness in bidding was modelled by analyzing entire bid distributions, competitiveness within bids, and competitiveness between bids for firms of a range of sizes and contracts of varied size. Competitiveness for each bidder respectively was measured by the ratio of the lowest bid received to the bid submitted by the bidder in question. Bid variability for each bidder was determined by using the coefficient of variation of bids made by that bidder. The data comprised 190 contracts made up of 2395 bidding attempts from 195 bidders for the period 1980-90.	https://doi.org/10.1080/014461997372836	27-Jun-19
11	Egemen, M. & Mohamed A. N. (March 2007). A framework for contractors to reach strategically correct bid/no bid and mark-up size decisions, Building and Environment, 42 (3), pp.1373-1385.	This study explores the factors that characterize the sequential stages of bidding decisions (bid/no-bid and mark-up size decisions) to guide contracting organizations in reaching 'strategically correct' bidding decisions. The findings show that the importance assigned to factors for the two separate decision processes, but factors related to 'strategic considerations' played a significant role in both decision processes.	80 small- to medium-sized contracting organizations were surveyed and the data for the sample was collected via questionnaires. Respondents were asked for their perception of importance (on a scale of 0 to 6) attached to the criteria listed while making the two decisions: bid/no bid and mark-up size decision for a specific project under certain circumstances. These criteria were divided into the following categories: need for work, strength of firm, project conditions contributing to the profitability of the project, job uncertainty, job complexity, risk creating job and contract conditions, client and consultant of the project, economic conditions and instability, availability of resources within the region, laws and government regulations in construction, competition (regarding the current project), competition (regarding the current market conditions), foreseeable future market conditions and firm's financial situation, client (considering long-term gains/losses), project (considering long-term gains/losses), and consultant firm (considering long-term gains/losses). The findings show that competition plays the most prominent role in firm mark-up decisions. However, for bid/no bid decisions, the most important factors were the need for work, project profitability, client and consultant of the project, and strength of the firm.	https://doi.org/10.1016/j.buildenv.2005.11.016	27-Jun-19

#	LITERATURE	STUDY DESCRIPTION	KEY STUDY INFORMATION	URL/DOI	DATE ACCESSED
Contractor Competition: How can Caltrans meter its advertising to maximize the number of bidders on its projects?					
12	Bezer, D. (September 22, 2010). The Inadequacy of Surety Bid Bonds in Public Construction Contracting, Public Contract Law Journal, 40(1), pp. 87-146.	This study evaluates the efficacy of different methods of advertising public construction contracts and the legal and financial repercussions of a contractor defaulting on their bid bond. The text also delves into the impact of sureties in public contracting to allow contractors to avoid the consequences of bid withdrawal. Damages are thus generally incurred and absorbed by the government, and rarely do courts permit confiscation of the bidder's security as reimbursement for the government's expense of re-advertising after the bid withdrawal.	The findings show that if a public entity advertises, through either an Invitation to bid (ITB) or Request for Proposals (RFP), allows more competitive bidding and thus lower costs of projects accomplished through contracting. ITBs are designed to attract suppliers at the least expensive price, whereas RFPs place greater emphasis on the quality of the product. (I.e. for public construction contracts that are not in the design-build model of project delivery, advertisement of a project will usually be via ITB.)	https://www.jstor.org/stable/pdf/25755803.pdf?seq=1	9-Jul-19
Workforce Availability: Are there sufficient skilled laborers available for the construction industry in California?					
13	Bilau, A. A., Ajagbe, A. M., Sholanke, A. B., Sani, T. A. (2015) Impact of Employee Turnover in Small and Medium Construction Firms: A Literature Review. International Journal of Engineering Research & Technology (IJERT), 4 (2). pp. 977-984. ISSN 2278-0181	This study conducts a literature review and examines the effects of employee turnover rates on productivity of labor in construction industries. Limited resources allocated to recruitment, training, and employee development exacerbates rapid employee turnover among new workers in the industry, particularly in small- and medium-sized firms.	This study primarily performs a literature review and analysis of research conducted regarding the impacts of employee turnover in construction industries. Research focused on the following areas of impact: incurred cost, decreased job performance, cost of recruitment and training, lower knowledge base, and accident-prone employees. The findings suggest that effective methods to reduce employee turnover are employee training, mentoring programs, effective feedback, positive work culture, effective leadership, fringe benefits, and recruiting from within the organization.	http://eprints.covenantuniversity.edu.ng/5133/#.XRUN5WaWyUk	27-Jun-19
14	Bohn, S. (September 2014). California's Need for Skilled Workers. Public Policy Institute of California.	This study predicts that California is likely to face a shortage of workers with some college education but less than a Bachelor's degree by 2025. The construction sector is predicted to be a "high-growth" area in the economy, leading authors to suggest that state and federal policymakers should continue to boost educational, vocational, and networking opportunities among this segment of the workforce.	The Public Policy Institute of California collected American Community Survey data to compute trends and forecast shortages in skilled labor. By 2025, the shortage of workers with some postsecondary education but less than a bachelor's degree is anticipated to be 1.5 million.	https://www.ppic.org/publication/californias-need-for-skilled-workers/	27-Jun-19
15	Buckley, B. (July 2019). Construction Staff May Be Set for 4% Raises in 2019, Engineering News-Record 2Q Cost Report, pp.	This article gives an overview of salary forecasts for 2019 based on industry surveys, with a higher-than-average pay increase due to growing demand and skilled labor shortage. The author also examines how work-life balance benefits may be used as a substitute for some wage increases.	The study refers to the annual compensation survey by consultant Personnel Administration Services. PAS president Jeff Robinson expects that salary raises could approach 4% this year and a similar trend is predicted to continue into 2020. Many companies struggle with employee searches, especially for superintendents with experience on complex projects, which drives salaries up. Construction companies are now more willing to consider and promote younger candidates. Similarly, due to increasing employee interest in work-life balance, recruitment strategies can reflect relocation support rather than higher compensation.	https://www.enr.com/articles/47184-construction-staff-may-be-set-for-4-raises-in-2019?v=preview	4-Jul-19

#	LITERATURE	STUDY DESCRIPTION	KEY STUDY INFORMATION	URL/DOI	DATE ACCESSED
16	Dai, J, Goodrum, P.M., and Maloney, W.F. (2007) Analysis of craft workers' and foremen's perceptions of the factors affecting construction labour productivity, Construction Management and Economics, 25:11, 1139-1152.	This study identifies 83 factors that impact construction labor productivity among 18 focus groups with craft workers and their immediate supervisors on nine jobsites throughout the U.S. The findings indicate significant differences that may contribute to more effective future construction labor improvement strategies.	Nine industry construction projects were selected from across the U.S. with varying types of construction, union/non-union work status, geographic location, status of completion, and project size to form 18 focus groups to identify factors affecting construction labor productivity. Using the 83 factors identified in the focus groups, a survey was conducted. The first section of the survey collected demographic data on the respondents. The second asked craft workers to rank the frequency and severity of 26 factors in impacting productivity. The third investigated respondents' agreement with 57 statements regarding issues of a continual nature and their perception of the factors' impact on productivity.	https://www.tandfonline.com/doi/abs/10.1080/01446190701598681	27-Jun-19
17	Dai, J., Goodrum, P. M., Maloney, W. F., & Srinivasan, C. (May 2009). Latent Structures of the Factors Affecting Construction Labor Productivity. Journal of Construction Engineering and Management, 135(5), 397–406.	This article is essentially the same as the above (based on the same focus groups and written by the same authors), but focuses on the 18 latent factors affecting construction labor productivity.	Nine industry construction projects were selected from across the U.S. with varying types of construction, union/non-union work status, geographic location, status of completion, and project size to form 18 focus groups to identify factors affecting construction labor productivity. Using the 83 factors identified in the focus groups, a survey was conducted. The first section of the survey collected demographic data on the respondents. The second asked craft workers to rank the frequency and severity of 26 factors in impacting productivity. The third investigated respondents' agreement with 57 statements regarding issues of a continual nature and their perception of the factors' impact on productivity.	https://doi.org/10.1061/(ASCE)0733-9364(2009)135:5(397)	27-Jun-19
18	Karimi, H., Taylor, T. R. B., & Goodrum, P. M. (2017). Analysis of the impact of craft labour availability on North American construction project productivity and schedule performance. Construction Management and Economics, 35(6), 368–380.	This study examines the relationship between craft labor availability and project performance, as measured by productivity and schedule. Projects experiencing craft shortages underwent substantial reduction in productivity and increase in schedule overruns. Similar relationships were shown between increased difficulty in craft recruiting and worsened productivity/schedule results.	Two data sources were used for this study. The first was a primary data collection effort through a CII Research Team 318 survey, which collected project performance and workforce demographic data on completed construction projects in the U.S. and Canada. There were 29 total responses to the survey. The second source was obtained through the CII Benchmarking and Metrics database and reported data related to the availability of craft workers. This source consisted of 68 completed projects in the U.S. and Canada. Analysis shows the average, median, and range of the size of projects in terms of actual cost, actual time, and actual craft direct work hours. Estimates of the level of craft shortage in projects relied on the subjective evaluations of the project management team.	https://doi.org/10.1108/CI-10-2015-0050	27-Jun-19
19	Karimi, H., Taylor, T. R., Goodrum, P. M., & Srinivasan, C. (2016). Quantitative analysis of the impact of craft worker availability on construction project safety performance. Construction Innovation, 16(3), 307–322.	This study aims to quantify the impact of skilled craft worker shortage on construction project safety performance using a database of 50 North American construction projects.	A t-test and Mann-Whitney test were used to determine whether there was a significant difference in the construction project safety performance on projects with craft worker recruiting difficulty. Poisson regression was then used to examine the relationship between craft worker recruiting difficulty and OS&H incidents on construction projects. This implicitly conveys another aspect of the costs and delays in construction projects associated with a skilled labor shortage.	https://www.tandfonline.com/doi/abs/10.1080/01446193.2017.1294257	27-Jun-19

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20	Kleiner, B. H. & Yankov, L. (January 2001). Human Resources Issues in the Construction Industry. Management Research News, 24(3/4), pp. 101-105.	This study reviews changing demographics in the workforce and a decrease in the number of qualified workers and experienced managers in the construction labor market in the U.S. The findings cite worker participation, recognition, cultivation of a sense of team belonging, leadership, and effective training as areas for improvement to mitigate this issue.	This study provides qualitative evaluations of several U.S. construction companies in terms of their success in managing human resources. It also synthesizes pertinent research papers to summarize HR management theories and methods of employee motivation to overcome changes in labor supply and demographics.	https://www.deepdyve.com/lp/emerald-publishing/human-resources-issues-in-the-construction-industry-MRxjipw4FY	27-Jun-19
21	Mcdermott, C. P. (2009). The Future of the Construction Industry and the Implications for Construction Project Management and Education (Graduate Thesis and Dissertation). Iowa State University: Ames, IA.	This study examines the production processes utilized by the global construction industry. Notably, it cites the low replenishment rate of workers in this industry due to negative perceptions that cannot outweigh the retirement rates. Additionally, while the retirement age of 65 is not appealing among high-level workers in the industry, physical occupations do not appeal to high-skill, older workers. This results in a decreased availability of trade workers that require more training, such as plumbers, electricians, carpenters, as well as in labor-intensive trades like iron and concrete workers.	Future methods, such as scanning, trend analysis, trend monitoring, trend projection, scenarios, polling, and brainstorming were used to develop estimates of sector changes in the construction industry. Medium- and long-range horizons were applied to a survey of CII member companies, interviews of construction industry representatives, and a comprehensive literature review. CII firms have had success in recruiting college age students, partly due to an increased emphasis on recruiting. Findings show a lack of workers aged 35-55, as retiring managers are replaced by young, inexperienced new hires. This gap is explained by economic, technological, and demographic conditions. This poses problems in interaction between the old and young in the construction industry, as the two generations have different experiences with communications technologies and values about work-life relationships.	https://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1601&context=etd	27-Jun-19
22	Snipsmag/Contractor Corner. 2017. National Association of Home Builders. Residential construction offers growing job opportunities, but skilled labor shortage remains. www.Snipsmag.com/contractorcorner, 86(1), 38.	This article uses data from the Bureau of Labor Statistics and the National Association of Home Builders to reflect the shortage of skilled labor in the construction industry, despite growing job opportunities.	In July 2016, there were 214,000 open construction jobs in the U.S., which was the second-highest monthly count since 2007. The Home Builders Institute is offering educational programs in 41 states and D.C., reaching more than 13,000 students each year, and also offers membership to the National Association of Home Builders, training, and networking opportunities.	http://digital.bnpmedia.com/publication/?i=371503&article_id=2672062&view=articleBrowser&ver=html5#{%22issue_id%22:371503,%22publication_id%22:%229661%22,%22page%22:40}	27-Jun-19
23	Olsen, D., Tatum, M., & Defnall, C. (2012). How Industrial Contractors are Handling Skilled Labor Shortages in the United States, ASC Annual International Conference Proceedings: Vol. 48. Auburn University, Auburn, AL: Associated Schools of Construction.	This study examines the skilled labor shortage in the heavy and civil engineering construction industry (i.e. industrial construction). It also investigates programs being utilized by industrial contractors to help train and equip an increasingly unskilled labor force.	In the U.S., industrial construction contributes around 4 percent of the annual GDP. Its percent contribution to GDP has increased annually up until the recent economic downturn of the late 2000s. The construction sector employs over seven million full-time and part-time employees and, of these, approximately one million are employed in industrial construction. Since the early 1980s, this industry has experienced a severe shortage of skilled craft labor and it is expected to be a long-term issue, despite economic downturns and fluctuations.	http://ascpro0.ascweb.org/archives/cd/2012/paper/CPGT204002012.pdf	6-Aug-19

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24	Schwatka, N. V., Butler, L. M., & Rosecrance, J. R. (2012). An Aging Workforce and Injury in the Construction Industry. Epidemiologic Reviews, 34(1), 156–167.	This article studies the impact of ageing populations on the state of the construction industry, citing higher costs of injury and disability due to occupational hazards. However, the number of injuries is not shown to be associated with age.	Due to the Baby Boom, the economic recession in the early 2000s, and a growing number of employees delaying retirement, the proportion of older workers is increasing. In the construction industry, this trend of aging labor population must be paid particular attention to because the construction industry is physically demanding, its injuries and illnesses are among the most costly, there is a greater likelihood of chronic illness, and older workers face greater risk from injury.	https://doi.org/10.1093/epirev/mxr020	27-Jun-19
25	Vereen, S. C. (2013). Forecasting Skilled Labor Demand in the US Construction Industry, Graduate Faculty of North Carolina State University.	This study applies a supply-and-demand model to the construction labor markets, evaluating the impact of worker and employer incentives on this model. Focusing on demand, the authors use interest rates, material prices, construction output, productivity, and real wage to forecast labor demand in the construction industry in the U.S.	The model developed in this research used vector autoregression to formulate and compare different forecast scenarios through 2023. There will be a likely need of approximately 5.3-6.3 million skilled laborers needed in the construction industry by 2023.	https://search.proquest.com/docview/1513569810/?pq-origsite=primo	27-Jun-19
Workforce Availability: How will trucking availability affect materials delivery and Caltrans project costs?					
26	Costello, B. & Suarez, R. (October 2015). Truck Driver Shortage Analysis 2015. American Trucking Associations: Alexandria, VA.	This study examines demographic and economic trends in truck driver labor, as well as its causes and effects.	In 2014, the shortage of drivers in the trucking industry was 38,000. In 2024, it is forecasted to increase to almost 175,000. Moreover, finding adequately qualified truck drivers is increasingly difficult as industry standards of professionalism and safety. The average age of a truck driver in the U.S. is 39 years. Women are strongly underrepresented in this occupation. On the other hand, more than a third of truck drivers are minorities.	https://www.trucking.org/ATA%20Docs/News%20and%20Information/Reports%20Trends%20and%20Statistics/10%206%2015%20ATAs%20Driver%20Shortage%20Report%202015.pdf	1-Aug-19
27	Ghilotti, M. (2018). Rail Transportation of Aggregate Material. California Polytechnic State University: San Luis Obispo, CA.	This study reviews the transportation costs of construction aggregates (integral materials for infrastructure projects) and compares the efficiency of trucking and rail modes of transportation based on varying factors. The study reviews increasing trucking cost, environmental impacts, and legislative resistances to determine how trucking may satisfy construction aggregate shipping demands and under what circumstances rail freight becomes a feasible substitute.	The findings show that rail becomes more competitive with trucking as distance traveled and quantity transported increases. The yearly demand for aggregates in the state of California is estimated to be 2.2 million tons. The study develops cost estimates based on mileage, fuel costs, equipment costs, time, and amount transported per trip for each mode of transportation.	https://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1158&context=cmsp	27-Jun-19
28	Min, H. & Lambert, T. (2002). Truck Driver Shortage Revisited, Transportation Journal, 42(2), pp.5-16.	This study reviews the impacts of driver shortages and high truck driver turnover, including cost inflation and service disruptions, impeding the firm's competitiveness. In attempts to control high driver turnover rates, trucking firms have implemented pay raises, bonuses, equipment upgrades, and flexible schedules. The article also studies the impacts of these strategies on turnover and driver shortages.	In 1992, for-hire truckload carriers often had 100-200% annual driver turnover rates, whereas the median employee turnover in the U.S. was 8.4 percent. Labor shortages increase costs and degrade the profitability of freight carrier firms, evoking a rise in freight rates.	https://www.jstor.org/stable/i20713518	1-Aug-19

#	LITERATURE	STUDY DESCRIPTION	KEY STUDY INFORMATION	URL/DOI	DATE ACCESSED
29	Simonson, K. (September 17, 2019). The Economic Impact of Construction in the United States and California. The Associated General Contractors of America.	The fact sheet analyses the economic impact of construction, the nonresidential construction spending, construction employment, construction industry wages, and small businesses in the construction industry.	The fact sheet estimates that there were just over seven thousand construction firms in California serving all markets with at least 20 employees and 1,089 firms with at least 100 employees as of 2016. The construction industry in the U.S. contributed 4.1% towards the total 2018 U.S. gross domestic product (DGP). The construction industry contributed 3.8% of California's state domestic product (SDP). The fact sheet estimates that the California construction industry wages average $70,084 in 2019, 3% more than the state average for all private-sector employees, 68% of construction firms in California had difficulty filling hourly craft worker positions.	https://files.agc.org/files/economic_state_facts/CA%20fact%20sheet.pdf	7-Dec-19
30	Trego, T., & Murray, D. (August 1, 2009). An Analysis of the Operational Costs of Trucking, TRB 2010 Annual Meeting: Arlington, VA.	The research objective focused on the identification of current, accurate motor carrier costs that derive from transportation system operations. ATRI developed, beta-tested and distributed a survey to a cross-section of for-hire motor carriers, representing the predominant industry sectors. Survey responses were aggregated and analyzed. When necessary, costs per mile (CPM) were converted to costs per hour (CPH) using an industry accepted average operating speed. Total marginal costs for the industry were $1.73 per mile and $83.68 per hour. Marginal costs were divided into vehicle- and driver-based. Top costs for carriers were diesel fuel/oil, driver wages and truck/trailer lease or purchase payments. The Specialized sector had the highest total marginal CPM, followed by the Less-than-Truckload (LTL) and Truckload (TL) sectors.	In 2006, the $645.6 billion U.S. trucking industry accounted for nearly 84 percent of the nation's freight bill; delivered 87 percent of all goods, and employed almost 9 million people. There is increasing demand for trucking freight services, but long-term issues of driver shortage and low retention rates persist. The U.S. Department of Labor's Bureau of Labor Statistics estimates that the mean national average pay for heavy duty truck drivers is $37,560 and the hourly mean pay rate is $18.06 per hour. The average driver pay per mile is 44.1 cents per mile.	http://truckingresearch.org/research/results/ATRITRBOpCosts.pdf	6-Aug-19
Workforce Availability: Will Caltrans' workforce changing with retirement and new hiring affect Caltrans' capacity to deliver projects as needed?					
31	Butler, J. and Harrington, M. (2018). Workforce Challenges in Implementing Transportation System Management and Operations within Caltrans. University of California Institute of Transportation: Berkeley, CA.	This study explores major impediments to hiring data analysts and software engineers at Caltrans. Opportunities for addressing barriers include developing appropriate recruitment strategies for software related positions, educating agency personnel on the need for data analysis and software skills, changing the requirements for positions in Caltrans traffic operations, and establishing a management team to coordinate and support these efforts.	The System Metrics Group was consulted by Caltrans to assists with defining a new organizational structure for corridor management, including outlining human requirements. When surveying Caltrans employees about the need for hiring software engineers and data analysts, older employees responded negatively and tended to oppose change to the work culture, while younger employees tended to be more receptive. Education, modifications to salaries and recruitment processes, and understanding from management teams of the need for data analyst and software positions are necessary to overcome the challenges of the shift. The findings from employee perceptions show that the wave of government retirements provides an opportunity for cultural and knowledge renewal to integrate technology in project delivery.	https://escholarship.org/uc/item/4j3023xk	4-Jul-19

#	LITERATURE	STUDY DESCRIPTION	KEY STUDY INFORMATION	URL/DOI	DATE ACCESSED
32	California Department of Transportation - Mile Marker. (Summer 2018). Caltrans Building Up its Workforce - Recruiting Efforts Stepped Up to Meet SB 1 Demands, Offset Attrition.	This document describes how Caltrans struggles with an ongoing wave of retirement and increased demand for workers due to SB 1. Caltrans is expanding its efforts to recruit and train and retain employees. The document analyzes the composition of Caltrans' workforce by generation, and the efforts the department its doing to retain institutional knowledge of their experienced staff.	Considering that Caltrans is facing an aging workforce, it has increased its efforts to recruit, train, and retain experienced employees. Around 54 percent of Caltrans workforce is 50 or older. A total of 67 percent of these workers are managers and supervisors. Millennials (the generation born between 1982 and 1997) only make up 14.5 percent of Caltrans' workforce. Caltrans is also making a strong effort to retain the institutional knowledge of its experienced staff before they retire.	https://dot.ca.gov/-/media/dot-media/programs/risk-strategic-management/documents/mile-marker/mm-2018-q2-recruitment-a11y.pdf	28-Nov-19
33	California Department of Transportation - Mile Marker. (Winter 2019). Caltrans Adds Muscle for Heavier Workload - State Budget Includes More Money to Hire Staff, Deliver Wide Range of Projects	The document explores how the increased of Caltrans' budget will allow the department to increase their staff.	The increase of Caltrans' budget will allow the department to increase its staff to 20,258 professionals. Of the 20,258 positions budgeted for the fiscal year 2019-2020, a total of 8,770 employees are designated for capital outlay support (Caltrans' largest workforce sector). The department's division of maintenance, rehabilitation, and repairing the highway system, has the next highest employee total at 6,522. Even with the overall increase allocated for personnel for the fiscal year, Caltrans will still have almost 10 percent fewer budgeted positions than it did in the fiscal year 2008-2009.	https://dot.ca.gov/-/media/dot-media/programs/risk-strategic-management/documents/mile-marker/mm-2019-winter-budget-a11y.pdf	28-Nov-19
34	Gallagher, S., and Villwock-Witte, N. (2016). Millennials in the Transportation Workforce, Transportation Research Record: Journal of the Transportation Research Board, Vol 2552, Issue 1, pp. 43-47.	Generational differences in the USA are of increasing concern to human resource professionals as they prepare to deal with the speedy demographic shifts expected in the transportation workforce. The paper contextualizes challenges faced by state departments of transportation on generational differences to identify mutual concerns.	The study found that DOTs across the countries offer many attributes that attract the younger generation such as job security, opportunities for personal and professional development, flexible schedules, and vacation and work expectations that allow for work-life balance. DOTs shared issues regarding the use of technology and social media, mentorship capacity, attrition, and public image. Millennials are rapidly becoming the largest generational cohort within the transportation workforce. Nevertheless, baby boomers continue to hold the majority of management positions. The study highlight that there are distinct generational differences in work ethics, values, and expectations that may lead to intergenerational conflicts within the workplace.	https://journals.sagepub.com/doi/10.3141/2552-06	16-Dec-19
35	Harper, C., Bogus Halter, S., Kommalapati, R., & Choe, D. (2018). Recruiting, Retaining, and Promoting for Construction Careers at Transportation Agencies. Transportation Consortium of South-Central States	Departments of Transportation (DOTs) across the country are facing complex challenges in recruiting and retaining sufficient staffing levels. The situation is been exacerbate due to the number of employees from different generations that have to work together with varying values, expectations, and principles. DOTS are primarily composed of two generations: the baby-boomers, who are approaching retirement and occupy many managerial positions; and the millennials, who are showing interest in technology and demanding dynamism in their careers. The study studies the practices in recruiting, training, and retaining qualified employees at DOT from Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.	The study found that DOTs cannot compete with the private sector regarding salary offers and compensations. Positions of engineers, equipment operators, maintenance personnel, surveyors and inspectors are difficult positions to fill as private firms offer more money for these positions. The study highlight that the challenges in recruiting and retaining the workforce are due to demographic changes in the workforce, competitive labor market, new technologies, and the overall demand for the transportation industry.	https://digitalcommons.lsu.edu/cgi/viewcontent.cgi?article=1019&context=transet_pubs	16-Dec-19

#	LITERATURE	STUDY DESCRIPTION	KEY STUDY INFORMATION	URL/DOI	DATE ACCESSED
36	Joaquin, M. E. & Greitens, T. J. (August 2012). Contract Management Capacity Breakdown? An Analysis of U.S. Local Governments. Public Administration Review, 72(6), pp. 807-816.	This study examines the capacity of local U.S. governments to internally manage contracting activities. The findings show a correlation between a decline in some aspects of capacity and governments contracting out for highly complex services. The authors speculate on the reasons and suggest capacity enhancement strategies.	Contract management includes the rating of bids, awarding of contracts, negotiations, and contract administration. The study looks at local contracting efforts from 1997 to 2007 to determine whether contract management capacities decline as the volume or complexity of services contracted out increases. The findings show public-private partnerships complicate contract management requirements.	https://doi.org/10.1111/j.1540-6210.2012.02587.x	27-Jun-19
37	Legislative Analyst's Office (August 28, 2018). MOU Fiscal Analysis: Bargaining Unit 9 (Professional Engineers)	LAO released a memorandum of understanding regarding a proposed labor agreement between the state and the Bargaining Unit 9 (professional engineers). The memorandum review the difficulty experienced by Caltrans hiring labor in the fiscal year of 2017-2018.	The memorandum The memorandum highlights that Caltrans has struggled to hire capital outlay support staff – including new engineers at Caltrans. In the fiscal year of 2017-2018, Caltrans hired on average 53 employees and lost 41 each month, for a net increase of 14 employees each month.	https://lao.ca.gov/Publications/Report/3880	20-Nov-19
38	Legislative Analyst's Office (May 13, 2018). The 2018-19 Budget: The May Revision - Governor's May Revision Proposal for Caltrans' Capital Outlay Support Program	In the May revision of the 2018-19 budget, LAO provides a background on the capital outlay support (COS) program. The COS program provides Caltrans the necessary staff support to deliver transportation infrastructure projects. The revision also describes the Governor's proposal for the 2018-19 budget and identify issues for legislative consideration.	The document shows that the change in budgeted employees who are part of the capital outlay support program (COS) between FY2017-18 and FY2018-19 was set at 9%. According to the administration, the main reason for the proposed increase is the increase work created by the new SB1 workload. COF staff conduct environmental reviews, design projects, acquire lands and manage construction work, among other activities.	https://lao.ca.gov/Publications/Report/3833	20-Nov-19
39	Selman, K., Khwaja, N., Machemel, R. B., Motamed, M., & LaVaye, C. (January 1, 2016). Evaluation of a Development Program for Transportation Engineers, Journal of the Transportation Research Board, 2552, pp. 32-42.	This study examines the shortage in qualified transportation engineers for leadership positions in state departments of transportation (DOTs). Four factors are influencing this shortage: firstly, that insufficient numbers of engineering graduates choose to work at DOTs; second, that those who do choose work at DOTs enter with transportation knowledge deficits, third, there are issues with retention; and fourth, increasing levels of experienced staff are retiring, adding to the expertise and leadership deficit. To compensate for this deficit, agencies are increasingly providing young unlicensed engineers with training that can include mentoring, functional area rotations, instructional training, and support for staff preparing to take the professional engineer exam. This study examines these steps taken on a national scale and in the state of Texas.	The research team performed a literature review and collected data about DOT training programs. Two surveys were conducted to compare programs at various DOTs and to assess the effectiveness of the training program from the Texas DOT Dallas District in improving staff performance (e.g., increasing staff attainment of professional engineer licenses, rapid promotion within the agency, leadership, improved retention rates). There is a trend of above average rates of retirement creating a deficit of experienced and knowledgeable public servants, exacerbated by incoming graduate engineers lacking diversified training and skills needed to assume the responsibilities of transportation system operations and management. Findings showed that training and internship programs and partnerships with colleges improve both retention and expertise and are thus positive investments.	https://journals.sagepub.com/doi/pdf/10.3141/2552-05	4-Jul-19
40	U.S. Department of Labor, Bureau of Labor Statistics. (November 5, 2019). Job Openings and Labor Turnover - September 2019 (USDL-19-1907).	This release of job openings and labor turnover by the Bureau of Labor Statistics includes estimates of the number and rate of job openings, hires, and separations for the nonfarm sector by industry and by four geographic regions.	This report shows the annual levels for hires, quits, layoffs and discharges, other separations, and total separations. The national separation rate for professional services is only 0.3 percent per year.	https://www.bls.gov/news.release/pdf/jolts.pdf	28-Nov-19

#	LITERATURE	STUDY DESCRIPTION	KEY STUDY INFORMATION	URL/DOI	DATE ACCESSED
Material and Product Availability: what can impact material and product availability?					
41	California Department of Transportation. (March 2018). Memorandum - 2018 Aggregate Resource Policy Statement and Tools	This memorandum highlights the importance of having aggregate sources of sufficient quality and closes to project sites that are essential in supporting a safe and sustainable transportation system in the state of California. The document explains the impact of having local aggregate resources. The document states that having local aggregates sites lead to a reduction of truck hauling to projects and processing facilities.	The memorandum includes a sample policy statement letter, construction aggregate supply limitations fact sheet, and the department of conservation map sheet 52 (2012), aggregate sustainability in California map. The construction aggregate supply limitations fact sheet provides the main end markets for aggregate with the approximate percentages. 43 percent of the aggregate produced in California goes to public infrastructure projects, which includes 26 percent of aggregate that goes to public highways, streets, and transit. Additionally, the shipping cost of aggregates can outweigh the cost of production if the aggregate it's transported more than 20 miles. Approximately five to six percent of the total of aggregate resource underlying mineral lands in California have been permitted by local agencies for mining activities. Environmental laws, land development, and zoning laws complicate the process of permitting of mining sites, currently, the process can take between five to ten years.	Provided by a focus group participant	27-Nov-19
42	California Geological Survey. (2018). Aggregate Sustainability in California (CGS, Map Sheet 52). Department of Conservation.	This report provides general information about the current availability of, and future demand for, California's permitted aggregate reserves.	The findings show that the permitted aggregate reserves fall drastically short of the 50-year demand forecast; one aggregate study area is projected to have 10 or fewer years of permitted aggregate reserves remaining as of January 2017. Demand for aggregate is expected to increase as the state's population continues to grow and infrastructure is maintained, improved, expanded.	https://www.conservation.ca.gov/cgs/Documents/MS_052_California_Aggregates_Report_201807.pdf	27-Nov-19
43	The Economist. (August 8, 2019), American steel tariffs cut both ways for domestic producers.	This article analyses the short and long term impact of the 25% tariffs on steel imposed in March 2 018.	The article highlights that at the start of 2018 the price of hot-rolled coil was roughly $600, and by the summer after the implementation of the tariffs the, price increased to $800. The volume that American steelmakers shipped domestically was 5% in 2018 compared with the previous year. The article stated that the price today has slumped back to pre-tariff levels. The extra cash from raising prices, combined with an apparent rise in demand, induced steel companies to splash out on new capacity. But the long-term issue arises from the high cost of American Steel in the market. Overseas, America's high-cost producers cannot compete with cheap alloys from places like China. At home, the initial increase of volumes was caused chiefly by customers substituting domestic steel for suddenly pricier imports. One supporter of the tariff stated that the tariff stimulates "massive investment that will modernize the industry". But the author of the article states that high fixed costs and testy trade unions discourage companies from retiring old, inefficient blast furnaces.	https://www.economist.com/business/2019/08/08/american-steel-tariffs-cut-both-ways-for-domestic-producers	3-Sep-19

Appendix G

CHCCI Regression Model

California Highway Construction Cost Index (CHCCI) Regression Model

HDR developed a regression model in 2018 to estimate and forecast the California Highway Construction Cost Index (CHCCI)[1]. For the purpose of this study, HDR updated the model to reflect the latest available market conditions. In particular, the model was re-estimated with the most recent available data (up to Q3 2019) in EViews[2]. Note that state unemployment rate data from January 2014 to September 2018 were revised by the Bureau of Labor Statistics. The regression output is provided in Figure 1.

Figure 1: New Regression Results

Dependent Variable: LOG(CHCCI)
Method: Least Squares
Sample (adjusted): 1999Q4 2019Q3
Included observations: 80 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	4.507089	0.714072	6.311811	0.0000
LOG(CA DIESEL PRICE)	0.344801	0.077715	4.436752	0.0000
LOG(MORTGAGE RATE (-4))	-0.563350	0.123854	-4.548507	0.0000
LOG(CA UNEMPLOYMENT RATE (-4))	-0.382651	0.085020	-4.500689	0.0000
LOG(AVERAGE NUMBER OF BIDDERS)	-0.168331	0.071776	-2.345209	0.0218
1ST QUARTER SEASONAL DUMMY	0.111344	0.037177	2.995001	0.0038
2013Q3 DUMMY	-0.431988	0.142151	-3.038934	0.0033
LOG(CHCCI(-1))	0.356518	0.099604	3.579356	0.0006
R-squared	0.875370	Mean dependent var		4.554766
Adjusted R-squared	0.863253	S.D. dependent var		0.371023
S.E. of regression	0.137202	Akaike info criterion		-1.040091
Sum squared resid	1.355348	Schwarz criterion		-0.801888
Log likelihood	49.603640	Hannan-Quinn criter.		-0.944589
F-statistic	72.244410	Durbin-Watson stat		2.084553
Prob(F-statistic)	0.000000	Durbin h-stat		-0.832472

As expected, the new regression results are very similar to those obtained in 2018, because only four quarters were added to the sample period and economic conditions have not changed significantly. The *R*-squared, or coefficient of determination, is slightly higher (i.e., the model explains a slightly higher percentage of quarterly variations in the CHCCI) and all regression coefficients are statistically significant at the 5-percent level (i.e., the *p*-value is less than 0.05 for each variable). The sign and magnitude of the regression coefficients are the same as in the prior forecast (as shown in Figure 2). The percent difference in the regression coefficient is less than 5 percent, except for the first quarter seasonal dummy variable.

[1] HDR, Inc., *Construction Cost Escalation Study*, final report prepared for Caltrans, March 2019.

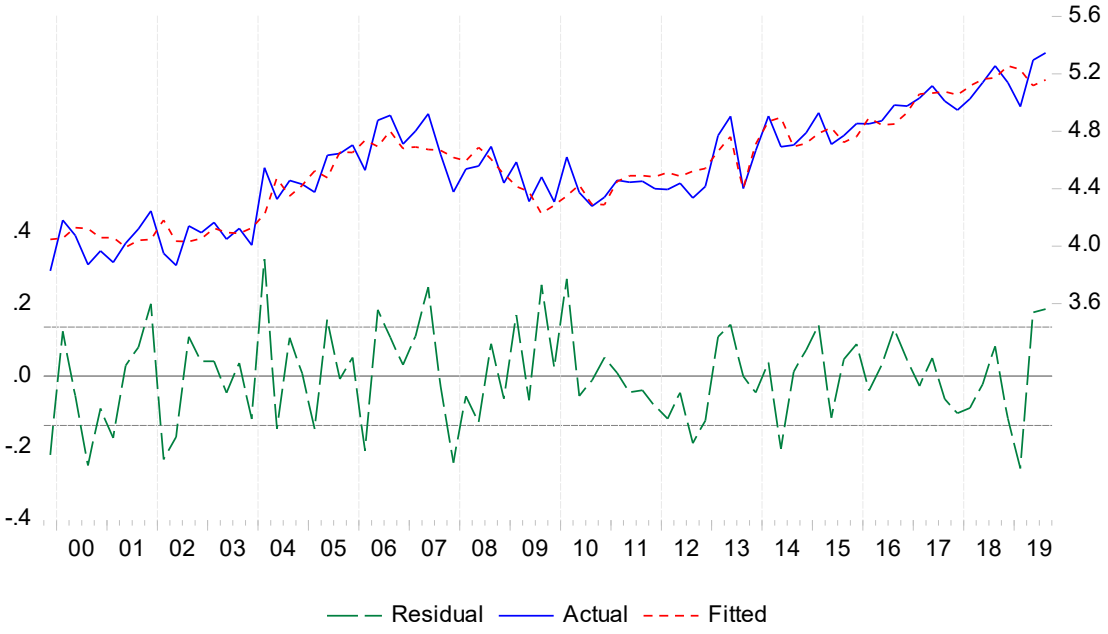
[2] http://www.eviews.com/home.html

Figure 2: Comparison of Old and New Regression Coefficients

Variable	Old Coefficient	New Coefficient	Percent Difference
CONSTANT	4.500570	4.507089	0.14%
LOG(CA DIESEL PRICE)	0.337331	0.344801	2.21%
LOG(MORTGAGE RATE (-4))	-0.569390	-0.563350	-1.06%
LOG(CA UNEMPLOYMENT RATE (-4))	-0.378305	-0.382651	1.15%
LOG(AVERAGE NUMBER OF BIDDERS)	-0.176799	-0.168331	-4.79%
1ST QUARTER SEASONAL DUMMY	0.130926	0.111344	-14.96%
2013Q3 DUMMY	-0.429506	-0.431988	0.58%
LOG(CHCCI(-1))	0.362120	0.356518	-1.55%

HDR assessed the robustness of the new model and its ability to forecast variability in the index values. Figure 3 graphically represents the actual values of the CHCCI (log-transformed), the fitted values (i.e., the natural log of the CHCCI as calculated by the model) and the model residuals (i.e., the discrepancies between the actual and fitted values, or what is left unexplained by the model) over the regression sample period. The graph shows that the model does a better job fitting the data after the first quarter of 2010.

Figure 3: Actual, Fitted and Residual Graph

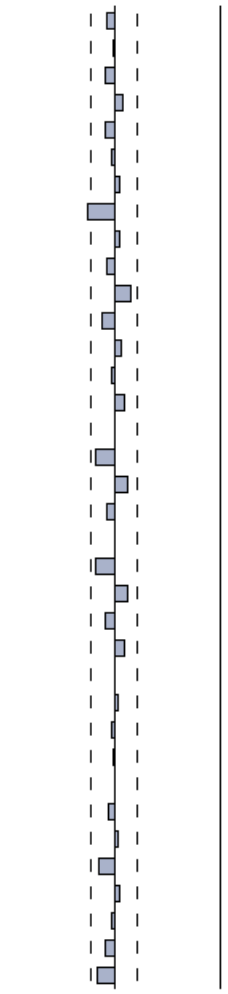


A correlogram of residuals and associated Ljung-Box *Q*- statistics are shown in Figure 4 on the next page. If there is no serial correlation in the residuals, the *Q*-statistics should be insignificant at all lags with large *p*-values (Prob.). The correlogram displays the autocorrelation and partial autocorrelation functions (ACF and PACF) up to the highest order of lag (36 in this case). The dotted lines in the ACF and PACF plots represent the approximate two standard error bounds. If the autocorrelation or partial autocorrelation is within these bounds, it is not significantly different from zero at the 5 percent significance

level. As shown in Figure 4, the correlograms and *Q*-statistics do not point to the presence of serial correlation in the regression model.

Figure 4: Correlogram of Residuals

Sample: 1994Q1 2019Q3
Included observations: 80
Q-statistic probabilities adjusted for 1 dynamic regressor

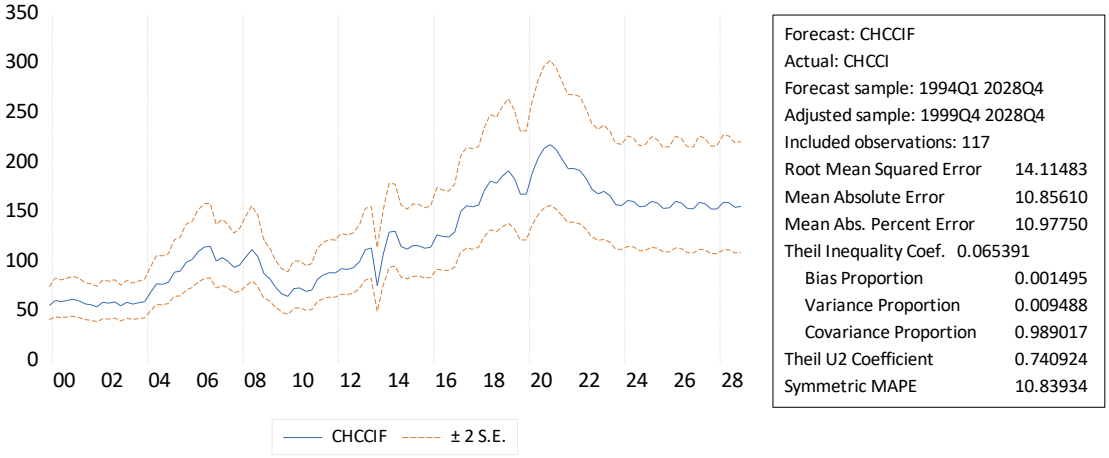


Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.073	-0.073	0.4419	0.506
		2	-0.006	-0.011	0.4449	0.801
		3	-0.082	-0.084	1.0236	0.796
		4	0.089	0.078	1.7142	0.788
		5	-0.088	-0.080	2.3989	0.792
		6	-0.017	-0.033	2.4241	0.877
		7	0.060	0.070	2.7506	0.907
		8	-0.258	-0.280	8.8315	0.357
		9	0.063	0.053	9.2000	0.419
		10	-0.078	-0.084	9.7715	0.461
		11	0.157	0.100	12.104	0.356
		12	-0.120	-0.052	13.484	0.335
		13	0.068	-0.003	13.930	0.379
		14	-0.031	-0.000	14.028	0.448
		15	0.090	0.076	14.852	0.462
		16	0.013	-0.018	14.869	0.534
		17	-0.175	-0.175	18.050	0.386
		18	0.126	0.102	19.734	0.348
		19	-0.068	-0.021	20.238	0.380
		20	0.011	-0.063	20.252	0.442
		21	-0.180	-0.112	23.861	0.300
		22	0.133	0.031	25.875	0.257
		23	-0.090	-0.009	26.817	0.264
		24	0.091	0.073	27.792	0.269
		25	0.012	-0.049	27.810	0.317
		26	0.044	0.059	28.044	0.356
		27	-0.020	-0.015	28.093	0.406
		28	-0.008	0.020	28.100	0.459
		29	0.009	-0.122	28.112	0.512
		30	-0.055	0.020	28.509	0.543
		31	0.034	-0.021	28.665	0.587
		32	-0.151	-0.072	31.776	0.478
		33	0.063	-0.005	32.327	0.500
		34	-0.026	-0.007	32.427	0.545
		35	-0.087	-0.128	33.529	0.539
		36	-0.161	-0.148	37.371	0.406

*Probabilities may not be valid for this equation specification.

Figure 5 below shows key evaluation statistics for the central forecast.

Figure 5: Forecast Evaluation



Alternative specifications of the regression equation were tested, however they did not yield better results. In particular, an attempt was made to account for SB 1 by means of a dummy variable, that takes on the value of 1 from the first quarter of 2018 onward and 0 otherwise, but it was not statistically significant.

Using the regression model presented above and external projections for all socioeconomic explanatory variables, HDR produced a quarterly forecast for the CHCCI through 2028.

Appendix H

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