

Addressing Transportation Construction Workforce Needs Through Innovative Policies and Practices

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16. Abstract A 2019 survey conducted by the Associated General Contractors of America, prior to the COVID-19 pandemic, found that construction firms across the country are struggling to fill open positions. Eighty percent of survey respondents indicated they have difficulty filling jobs in occupations that are essential to highway construction. This includes heavy equipment operators, cement masons, and iron workers, among others. ¹ This workforce shortage in California will become more problematic as public agencies and their contractors seek to implement projects funded by the Bipartisan Infrastructure Law (BIL), also known as the Infrastructure Investment and Jobs Act (IIJA). In California there are 1,536 bridges and over 14,220 miles of highway in poor condition. The IIJA will invest \$4.9 billion in the state for highway-related infrastructure projects. ² The research team conducted a literature review of three economic sectors that have faced or are facing similar labor shortage issues. The three sectors are agriculture, technology, and healthcare. Informal interviews were held to help explore and validate findings from the literature. Agriculture labor recruitment strategies offer some potential solutions to similar issues in highway construction because of the cyclical nature of work in each—the agricultural cycle of agricultural crops and the project cycle of construction. Solutions include foreign worker programs, employee referral programs, and improving working conditions. In the technology sector, there has been some success in filling specialized-skill positions with workers who have trained in online, modular skill training provided by large companies such as Google or Microsoft. Leading highway construction firms could form a public partnership to develop and provide similar trainings for the highway construction skills in demand. The healthcare sector has been addressing a shortage of low-skill workers for a longer period of time and offers the broadest potential solutions. There has been some success in finding workers using policies for tuition reimbursement and incentivizing seasoned professionals to become instructors for programs that provide in-demand skills. The hiring checklist for highway construction composed in this report is high-level so that it has broad applicability. The steps were informed by research into the comparative sectors. They offer a hiring process that is proactive to anticipated projects and aims to increase retention and reduce turnover.			
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Executive Summary

A 2019 survey conducted by the Associated General Contractors of America, prior to the COVID-19 pandemic, found that construction firms across the country are struggling to fill open positions. Eighty percent of survey respondents indicated they have difficulty filling jobs in occupations that are essential to highway construction. This includes heavy equipment operators, cement masons, and iron workers, among others.¹

This workforce shortage in California will become more problematic as public agencies and their contractors seek to implement projects funded by the IIJA. In California there are 1,536 bridges and over 14,220 miles of highway in poor condition. The IIJA will invest \$4.9 billion in the state for highway-related infrastructure projects.²

This report reviews problems and solutions related to workforce shortages in three comparative economic sectors that are facing similar issues: agriculture, technology, and healthcare. Lessons learned from these economic sectors are synthesized into a hiring checklist of best practices for addressing the workforce shortage in highway construction. This research was done in response to a Research Needs Statement submitted to San Jose State University by the American Road and Transportation Builders Association (ARTBA).

Employer- and employee-focused solutions identified in the three comparative economic sectors as potentially applicable to the highway construction sector include investment in training programs, development on-the-job skill development, and creating a policy mechanism for hiring temporary or contracted foreign workers without a large administrative or bureaucratic burden.

1. Introduction

A 2019 survey conducted by the Associated General Contractors of America prior to the pandemic found that construction firms across the country are struggling to fill open positions. Eighty percent of survey respondents indicated they have difficulty filling jobs in occupations that are essential to highway construction. This includes heavy equipment operators, cement masons, and iron workers, among others.¹

This report reviews problems and solutions related to workforce shortages in three comparative economic sectors that are facing similar issues: agriculture, technology, and healthcare. Lessons learned from these economic sectors are synthesized into a hiring checklist of best practices for addressing the workforce shortage in highway construction. This research was done in response to a Research Needs Statement submitted to San Jose State University by the American Road and Transportation Builders Association (ARTBA).

This workforce shortage is an even more acute problem in more recent years because of pandemic-generated labor disruptions and the need for workers to implement projects funded by the Bipartisan Infrastructure Law (BIL), also known as the Infrastructure Investment and Jobs Act (IIJA). In California there are 1,536 bridges and over 14,220 miles of highway in poor condition. The IIJA will invest \$4.9 billion in the state for highway-related infrastructure projects.²

This research contributes to the state's efforts to fill open transportation construction positions by documenting issues and best practices for workforce recruitment and retention from other economic sectors, factoring for differences in required education level, wage scales, and more. The result is recommendations and a hiring and retention checklist for highway construction.

1.1 Project Background and Motivation

The transportation construction industry faces workforce challenges that were heightened by the COVID-19 pandemic's quarantine and are being exacerbated by an accelerating demand for these workers as a result of the number of transportation and highway construction related projects being jumpstarted by the federal Infrastructure Investment and Jobs Act (IIJA). The ability to move projects from planning to implementation depends upon eligible and willing candidates for all types of positions, including skilled trades.

Highway construction and maintenance is a significant contributor to the nation's economy. In May 2024, Bureau of Labor Statistics (BLS) reported that there were approximately 367,580 people employed in highway, street, and bridge construction in the U.S. This does not include the 44,560 people employed in occupations tied to paving and surfacing or the nearly 150,00 highway maintenance workers estimated in 2021.³

Table 1 shows figures from the US Bureau of Labor Statistics from the summer of 2022 that show a robust job market in the entirety of the construction industry between July 2021 and July 2022. Hires, however, have not kept pace, and the numbers of total separations from layoffs and discharges are generally exceeded by self-terminations.

Table 1. Construction Industry Job Openings and Labor Turnover Data: November 2022

	November 2023	October 2023	November 2022	1-Month Net Change	12-Month Net Change	12- Month % Change
Total						
Job Openings	459,000	416,000	348,000	43,000	111,000	31.9%
Hires	362,000	379,000	337,000	-17,000	25,000	7.4%
Total Separations	351,000	345,000	294,000	6,000	57,000	19.4%
Layoffs & Discharges	171,000	163,000	146,000	8,000	25,000	17.1%
Quits	173,000	173,000	135,000	0	38,000	28.1%
Other Separations	7,000	10,000	14,000	-3,000	-7,000	-50%
Rate						
Job Openings	5.4%	4.9%	4.3%			
Hires	4.5%	4.7%	4.3%			
Total Separations	4.4%	4.3%	3.8%			
Layoffs & Discharges	2.1%	2.0%	1.9%			
Quits	2.2%	2.2%	1.7%			
Other Separations	0.1%	0.1%	0.2%			

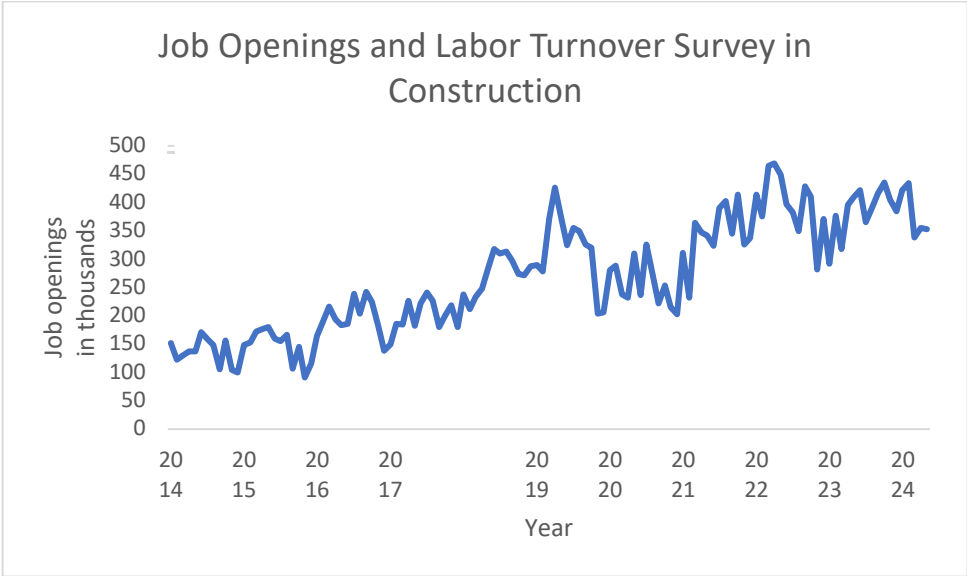
Source: Bureau of Labor Statistics (BLS)

The data is further supported by the Job Openings and Labor Turnover Survey (JOLTS) published by BLS and the industry’s own experiences. JOLTS data shows that over the past decade, job openings have been trending upwards with no indication of declining. The 2022 Workforce Survey Results reported by the Associated General Contractors of America (AGC), which involved nearly 1,300 employers nationwide, indicated that 93% of construction firms have open positions, and 91% are having trouble filling them. Unemployment rates in construction are lower than those of the overall economy, translating into a lack of available skilled workers for new positions.⁴ The shortage impacts not only project completion but may also translate into longer hours for existing workers with implications for worker’s mental health and safety.⁵

The results of the AGC survey for California mirror the national trends:⁶

- 76% of firms are having difficulties filling open positions (94% for salaried positions)
- 58% report that available candidates are not qualified to work in the industry
- 55% have experienced delays due to shortages of workers (directly or subcontractors)

Figure 1. JOLTS Construction Data 2014–2024



This workforce shortage in California will become more problematic as public agencies and their contractors seek to implement projects funded by the IIJA. In California there are 1,536 bridges and over 14,220 miles of highway in poor condition. The IIJA will invest \$4.9 billion in the state for highway-related infrastructure projects.

One of the interesting findings from the same California survey is that 7% of the employer respondents have applied for employment-based visas (H-1B, H-2B) in response to the demand for qualified workers. Increasing the available pool of applicants via policy and immigration-based approaches, including guest worker programs, is an approach that has been taken by other economic sectors. These include agriculture and the technology sector, but are untested in highway construction.

1.2 Methodology

The findings in this project are from a literature review of current sources and informal interviews with stakeholders in each of three economic sectors of interest that have faced similar labor shortages compared to the highway construction sector: agriculture, technology, and healthcare. Causes and solutions of labor shortages in each of the economic sectors were investigated, with

particular focus on the impact of changes in policies and processes. Research databases and search engines were used to look for reports and current articles on workforce shortages. There are very few academic papers that directly relate to the topic of acute workforce shortages in the selected sectors. Most of the papers found were focused on healthcare, since nursing shortages were identified early on. Only a handful of studies exist for agriculture, and the tech shortage is relatively new, so the problem is just starting to be researched. This indicates a need for further research on the issue. The research team’s network of workforce development stakeholders was the source of the informal interviewees.

1.3 Overview of Comparative Economic Sectors

Each of the sectors used as a comparison for highway construction is facing a similar labor shortage, despite differences in the nature of the work and the structure of workforce recruitment and retention. Table 2 lists some of the differences that affect the efficacy of labor shortage solutions.

Table 2. Overview of Economic Sectors

Agriculture	Technology	Healthcare
<ul style="list-style-type: none"> • Labor demand is cyclical in nature due to crop harvests • Labor currently in demand is low-skill or specialized-skill 	<ul style="list-style-type: none"> • Labor demand is due to too many workers without the right skills • Rate of need to update skills is faster than other sectors • Contracting out work makes sense for piecemeal deliverables 	<ul style="list-style-type: none"> • Labor demand is highest in lowest-skilled workers • Highest number of extant training programs and policy mechanisms to address shortage • Contract/temporary work often not feasible with healthcare where continuity of care is often required

Table 3 shows the typical level of education required to obtain an entry level position within each economic sector. Because each economic sector has a wide range of available positions, this table mostly focuses on the positions mentioned in the literature review. The table also shows how each economic sector views training programs. Agriculture only requires training if they are operating machinery which is outside the scope of work for most H-2A employees. Those in technology are starting to go through constant training to keep employees up to date with emerging technologies. Healthcare requires training as a part of becoming certified to work in the field. Highway construction offers in-house training for entry-level positions and support to obtain the certification required to do the job.

Table 3. Typical Education and Training Needed for Each Sector

	Agriculture	Technology	Healthcare	Highway Construction
Typical Education Level Required	None	Bachelor's	Bachelor's	Certificates
Typical Training Requirement	Required for higher-level occupations	Required for those in the workforce and to enter software development	Required	In-house available for entry-level positions, support for certifications available as well
Typical Training Provider	Employers	Employers/third-party companies	Various	State DOT/Employer

1.4 Overview of Labor Visa Requirements

Table 4 outlines different labor visas that have been available to foreign workers in the United States. These visas are required for foreign workers to be hired, which is helpful to address a labor shortage that cannot be resolved with domestic workers.

Table 4. Labor Visa Requirements

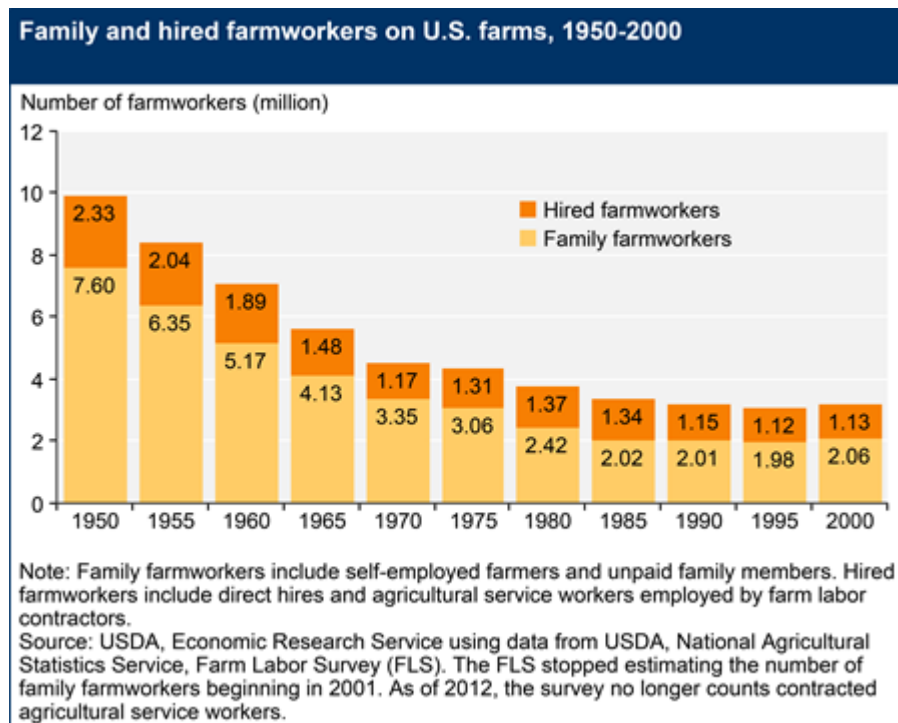
	H-2A Visa	H-1B Visa	H-1A Visa	H-1C Visa
Eligibility	Anyone provided they prove that they cannot find any qualified U.S. workers first	Degree holder or equivalent picked via lottery	No longer active; must submit offer for employment from employer and must prove that there are no qualified U.S. workers available	No longer active; must have full unrestricted nursing license in origin country or have nursing education and license in U.S., authorized by U.S. board of nursing to practice within the state, passed examination given by Commission on Graduates for Foreign Nursing Schools, fully qualified and eligible under state law to practice as an RN; only 500 visas were approved per year
Period	Seasonal	Year-round	5-year max	3-year period
Employer	Farmers responsible for finding workers	Employers must sponsor each H1B Visa holder	Any hospital	14 eligible hospitals
Special Wage (Not determined by Market)	Yes, AEWB set by region	Yes, Percentile based on location and industry	Prevailing RN wage within facility	Prevailing RN wage within facility
Housing	Provided by employer	Employee must find own	Employee must find own	Employee must find own
Travel costs	Paid by/reimbursed by employer	Employee responsible unless work period ends early	Employee responsible	Employee responsible

2. Agriculture

2.1 State of the Economic Sector

A 2018 survey released by the California Farm Bureau (CFB) reported that 55% percent of farm owners and managers surveyed had experienced farmworker shortages that year. The same survey in 2019 established that this problem has been something that California farmers have been struggling with for several years now, finding that 56 percent of participating farmers had been unable to hire all the employees they needed at some point during the previous five years.⁷ Anecdotal evidence is not the only proof that farmers are facing a labor shortage. In the study “Farm Labor Markets in the United States and Mexico Pose Challenges for U.S. Agriculture” by the United States Department of Agriculture (USDA), the Economic Research Service aggregated farmer interviews and tested them against the available data and concluded that there is statistical evidence pointing to a tightening labor market. Over the last decade, wages for hired farmworkers have risen, the gap between agricultural and nonagricultural compensation has narrowed, and use of the H-2A program has more than doubled. Moreover, net immigration from Mexico—the leading country of origin for foreign-born farmworkers in the United States—has slowed appreciably.⁸ According to the United States Immigration Service (USIS): “The H-2A program allows U.S. employers or U.S. agents who meet specific regulatory requirements to bring foreign nationals to the United States to fill temporary agricultural jobs.”⁹ The agricultural workforce shortage has been a well-known problem for several years. There is evidence from as early as 1950 when the “Farm Labor Survey (FLS) of USDA's National Agricultural Statistical Service (NASS), [demonstrated that] the number of self-employed and family farmworkers declined from 7.60 million in 1950 to 2.01 million in 1990, a 74-percent reduction.”¹⁰ Normally, such a decrease in self-employed and family labor would have to be replaced with hired workers or technological advancements to maintain a similar level of output, but the FLS survey states that the number of hired workers declined without any replacement, resulting in a sharp decrease in the overall workforce. Comparing the ratio between hired and family workers in 1950 (30.6%) and 2000 (54.8%), the industry has shifted from doing the work within the family business to hiring help; however, more importantly, the overall workforce has dropped significantly since the 1950s. In many other typical industries, it would be safe to assume that the reason for the decline in the workforce was due to advancements in technology. However, due to the large upfront cost of implementing mechanized solutions, especially for labor-intensive crops, farmers have not been able to invest in new technologies as hiring workers has been more cost effective up until now.

Figure 2. Family and Hired Farmworkers on U.S. Farms, 1950–2000



2.2 Why is There a Shortage

The retirement of the baby boomer generation is a major concern for the agricultural industry. CFB found in the 2018 survey that “34 percent of respondents reported their employees retiring or cutting back on hours due to their age.”¹¹ This suggests that the country is beginning to experience the effects of a shrinking generational workforce. Due to the large size of the baby boomer generation in comparison to subsequent generations, when the older generation completely phases out of the workforce, the workforce will experience a contraction. The smaller workforce made up of a younger generation with different working preferences means that it will be incredibly difficult for the agricultural industry to replace its lost workers. The mass retirement of the baby boomer generation will leave a labor force gap in every industry because of how large the generation is in comparison to the following generations. According to an article published by USA Today: “farmers said the recent trend toward rising wages for entry-level jobs is making it even harder to drum up interest.”¹² Rising minimum wages for entry-level jobs, such as in fast food restaurants, has made it more difficult for farmers to attract new workers because someone could choose to work on a farm or spend their time in a fast food kitchen where they would have to do significantly less work all while receiving a similar if-not-higher wage compared with the back-breaking work done on a farm. A study published in the American Journal of Agricultural Economics considered the implications that changes in wage levels and immigration reform produce in the labor market. They found that there is no reason why increasing wages would not alleviate the farmer’s inability to attract U.S.-born workers, but they also noted that the necessary increase in wages is unobtainable for farmers as they only have a “2% surplus to spend.”¹³ In

summary, farmers are unable to attract new workers because (1) they are unable to pay higher wages to compete with other industries, (2) incumbent workers are starting to retire, and (3) farmwork is difficult, and job seekers would rather work in a different industry with competitive pay and better working conditions.

2.3 Current Solutions

In the 2018 CFB survey, farmers were asked how they were planning on handling their workforce shortage. They responded that their “short-term plans include offering higher wages and other incentives (39 percent); planting less labor-intensive crops (16 percent); and planting fewer acres (10 percent). Some respondents indicated they are preparing to sell their land or lease parcels.”¹¹ The same study indicated that the majority of farmers suffering from a workforce shortage were those “who rely on peak-season hand labor and lack mechanical methods to harvest their crops [as they] continue to see employee shortages and [face]risk [to] crop losses as a result”¹¹ while those “that require fewer employees and use mechanization during the peak season generally have adequate numbers of people.”¹¹ The reason farmers with labor-intensive crops have not implemented mechanized solutions is due to the high cost associated with doing so compared to less labor-intensive crops. Crops such as tree fruits, nuts, and seeds require delicate picking otherwise they would be too damaged for the farmer to sell, so more specialized mechanization methods and equipment are required. In the past, it was more economical for farmers to hire workers for their seasonal harvest compared to investing in new technologies, but as wages increase, implementing new technologies may become the better option. Since farmers are unable to attract additional U.S. born workers, they are almost forced to use the government’s H-2A program.

2.4 Visa Based Solutions

According to the Department of Labor (DOL), the H-2A program “allows agricultural employers who anticipate a shortage of domestic workers to bring nonimmigrant foreign workers to the U.S. to perform agricultural labor or services of a temporary or seasonal nature”¹⁴ but the program has flaws. The process to apply for H-2A workers is extremely complicated. Farmers usually hire a lawyer to help with the application process, and, if approved, they must follow strict rules to be in compliance with the program. Farmers must pay a fee for labor certification, pay a filing fee, reimburse every worker’s consulate fees, pay a border stamp fee for every worker, and pay an agent fee for every worker. Employers are also responsible for the transportation costs associated with H-2A workers traveling from their home country to the U.S., as well as weekly travel to and from grocery stores. If farmers are located far from the job site, they are also responsible for providing housing for their workers and meals if cooking facilities are unavailable. Alternatively, if the worksite is close enough to the border, employees can have workers commute but are still responsible for their transportation costs. H-2A workers may be required to cover their own transportation costs but the employer must reimburse them after 50% of the contract has been completed; this stipulation has led to many abuses of the system since the employer can fire the farmworker before 50% of the contract has been completed.

There are many opportunities for employers to abuse the H-2A system. The H-2A program only allows for seasonal temporary work, which means they can only request workers if employers “need more help than usual because the work is tied to a certain time of year by an event or pattern, like a short annual growing cycle,”¹⁵ and the work cannot last for more than one year. This limits many farmers, such as those in the dairy industry who require year-round help but are unable to find any due to similar circumstances that the labor-intensive crop farmers face. Among the farmers who use the program, there are many reports of abuse happening on the farms. Despite the protections that the H-2A workers are supposed to have, they often find themselves in poor living conditions and are underpaid. H-2A workers are supposed to be paid a special wage known as the Adverse Effect Wage Rate (AEWR) that is the highest of the three following options: the federal or state minimum wage, the prevailing wage, or the local median wage for that job or the AEWR, which is the regional weighted average hourly wage rate for field and livestock workers combined. Most often the AEWR will be the required wage employers must pay; in California the AEWR is \$19.75 an hour. Some farmers will try to avoid paying such a high wage by trying to implement things such as paying employees for the amount of fruit they picked. Piece-rate earning is allowed by the H-2A program, but employers are required to supplement wages until it is equal to the minimum. Some employers will use piece-rate wages as a shroud for reporting that their employees worked less hours than they did to pay them less. A flaw in the H-2A system is how much power the employer has over their employees. Employees are only admitted into the country because of their employer, and, if they are terminated, they must return to their own country. Each H-2A visa holder has their visa attached to the employer that hired them, and, if they are fired, they are unable to legally work at any other farm in the country. This creates situations where the farm workers will not speak up for themselves in fear of retaliation. If visa holders decide to sue for any lost wages or violations they must first go back to their own country and start the process from there, which makes the process much longer and more expensive for the plaintiff.

2.5 Interview

A member of the agriculture economic sector in California validated the problems and solutions identified in the literature review. The interviewee shared that farm workers are leaving for other jobs that offer more competitive wages or better working conditions, and this issue is most acute for entry-level jobs. They shared that hiring is a particular challenge, rather than retention, and implementing solutions is often costly. They observe that inefficiencies arise from inexperienced labor filling the shortage.

A solution that the interviewee observed that occurs organically in California was the transition to crops that can be harvested more easily with automation and drip irrigation, which require less workers. Due to this transition, there is a growing need for training and degrees for higher paying jobs that support automation. There are training programs for certain specialized skills, such as forklift training and leadership development. Programs such as these have the potential to expand to other skills.

Other proposed solutions include job shadowing and apprenticeships to build pathways to positions with shortages, referral programs for new hires, and further automating field positions. The H-2A program was identified as helpful for filling certain specialized jobs but the employees are burdened by the bureaucratic administrative process.

3. Technology

3.1 State of the Economic Sector

Several polls and studies have been conducted to assess the workforce pool available to the computer and information technology sector. This sector is defined by the DOL as being comprised of “workers [that] create or support computer applications, systems, and networks”¹⁶ and is commonly referred to as the technology sector. They all report varying timelines and severity of the shortage, but they all agree that shortages exist and will become more severe in the future. The most general study was conducted by the Korn Ferry consulting firm which found that “the biggest issue isn’t that robots are taking all the jobs—it’s that there aren’t enough humans to take them. Indeed, the study finds that by 2030, there will be a global human talent shortage of more than 85 million people.”¹⁷ The Korn Ferry study refers to underlying issues present in the labor force or issues that will soon emerge. The same study says, “Much of the shortage is based on simple demography ... baby boomers will have moved out of the workforce by 2030, but younger generations will not have had the time or training to take many of the high-skilled jobs left behind.”¹⁷ The retirement of the baby boomer generation will proliferate across nearly every industry because of the shrinking labor force and, as pointed out by Korn Ferry, the incoming generation will not have had the time to acquire the training necessary to perform high-end tasks. Global tech leaders were polled in a survey “conducted by MIT Technology Review Insights, 64% of respondents say candidates for their IT and tech jobs lack necessary skills or experience. Another 56% cite an overall shortage of candidates as a concern.”¹⁸ Two additional independent surveys support the concerns found by the MIT survey; they state that workforce issues have been a top challenge for at least the past six months, and the other study says that about half of the respondents say that they are facing skill gaps and will continue to do so for the next five years. All these studies report various levels of severity and forecast different years, but they all agree that there will be a shortage in the industry.

3.2 Why is There a Shortage

As previously mentioned, one reason why the tech industry will face a workforce shortage is due to retirement, but there are several factors contributing to the issue. Bridge, an IT recruitment company, claims that

Technical progress and digital advancement created opportunities for replacing low-to-mid-level skilled workers with robotic process automation (RPA) solutions, allowing companies to cut costs and achieve better efficiency. But in exchange, they triggered unprecedented demand for workers whose skills complement new technologies. At the same time, the tech education system just can’t keep pace with the times and graduate enough students with the required skills.¹⁹

This claim aligns with Korn Ferry's claim that jobs are no longer being lost largely due to automation; instead, there simply are not enough people around to take them. The shift from manual work to automation created demand for new skills sets needed to operate new technology; consequently, the workforce had to retool their skillset or leave the industry. Today, the technology space requires constant skill retooling, and the rate at which it happens is rapidly increasing thanks to new advancements such as AI. Korn Ferry's claim is further supported by an article written by Cloud Academy, a company that specializes in teaching the skills needed to manage and create cloud systems. It says "The relentless pace of tech advances has intensified the demand for competent workers in almost all sectors. Companies struggle to secure proficient staff but usually come up short. The challenge that most businesses face is finding skilled personnel to accommodate the burgeoning technical roles that are springing up as trends and needs develop."²⁰ The biggest issues that the technology sector is facing today are the shrinking workforce and the lack of skills needed for cutting edge technologies.

3.3 Current Solutions

The technology sector has implemented several programs to address its workforce shortage. In the short-term, companies have been competing against each other to offer the highest salaries and benefits, but this method has its limits especially for smaller companies that cannot offer the same level of benefits that larger tech firms are able to offer. Tech firms know that seeking out potential candidates as soon as they graduate and offering them jobs is becoming a less effective tactic as more firms enter the market and the need for talent increases as major companies lose experienced workers. In response to the increased competition, companies have started to become more involved in producing new talent: "HCLTech has begun investing in young students through early-career programs that provide on-the-job training, while also offering them financial support toward their post-secondary education."²¹ HCLTech created this program to help solve their own workforce shortage but have expanded the program's vision to provide a supply of nontraditional tech workers; however, the current climate is not very accommodating to these kinds of workers. According to a poll done by them "Only 17% of respondents said their organization is currently recruiting candidates who have only a secondary school diploma, and only 29% recruit candidates with post-secondary training but no post-secondary degree."²¹ The only other option that the technology sector has available is the H1-B visa program which is a specialty occupation version of the H-2A program used in agriculture, but with different requirements.

3.4 Visa Based Solutions

The H-1B program requires a bachelor's degree or its equivalent, and unlike the H-2A program much of the paperwork and burden of the program is placed on the employer to sponsor an individual that they wish to work for them. The H-2A program requires farmers to recruit workers, but that is typically outsourced to agents that do the work for them. Similarly to the H-2A program, the H-1B program is intentionally set up to not adversely affect domestic workers. This is done by regulating the number of visas available and their pay. The pay rates of the H-1B

program depend on the job, location, and percentile of the highest paid workers; each job in every location should be paid the average or prevailing wage for that region. However, the DOL often sets the minimum wages too low and the maximum wages too high. The prevailing wage rule allows employers to pay H-1B visa holders at the 17th and 34th percentile which will always be lower than the intended local median wage, and the higher end of the pay range is usually reserved for holders with exceptional credentials. Each year visas are distributed via lottery, but those who held visas previously are allowed to reapply for their visa without adding to the overall lottery limit; this creates a slow growth of these workers in the industry.

3.5 Interview

A member of the technology economic sector in California gave insight into understanding and addressing workforce shortages in an informal interview with the research team. He identified the problem as a bit different in technology due to a large increase in hiring around 2021 that is now being shed because labor resources are not available in the right areas. Employees need to redevelop their skillset at a faster pace compared to other economic sectors.

One solution to the labor shortage that is currently in effect is outsourcing jobs to foreign remote workers. There is also fast, free, small modular training for specific skills provided online by companies such as Google and Microsoft. Additionally, for piecemeal tasks or deliverables, contracted and temporary workers are brought in. Similar solutions may be useful in the highway construction economic sector as well.

4. Healthcare

4.1 State of the Economic Sector

The healthcare shortage has been a concern for the sector since 2009 when the Institute of Medicine (US) National Cancer Policy Forum expressed worry about the potential shortage of physicians, nurses, and allied healthcare professionals in the future. In 2018, a study by consulting firm Mercer projected that despite a projected growth of 32% of home health aides, there would still be an expected workforce gap of over 400,000.²² The positions with the largest expected workforce gap consist of entry-level health care positions such as nursing assistants, home health aides, and medical and clinical lab technologists. A follow-up to the study was created in 2021, and it largely found the same results. Lower-wage positions will have a nationwide gap, but in states with major metropolitan areas, the gap will be severe. New York is expected to have a gap of over 600,000 workers. Washington State is expected to have a surplus of 160,000 workers but this is nowhere near the amount needed to fill in the nation's gap. The Mercer Study's claims were further supported by many other associations' reports and studies claiming that the shortage would occur, albeit with varying levels of severity. The country is expected to suffer a shortage of up to 124,000 physicians in the next 12 years, according to a 2019 report from the Association of American Medical Colleges²³ and "The Bureau of Labor Statistics projects that the country will face a shortage of 195,400 nurses by the year 2031;"²⁴ the BLS projects a shortage further out than the previous two studies but it shows that the problem has not had the necessary time or programs needed to fix their issues.

4.2 Why is There a Shortage

The incoming retirement wave will cause shortages throughout all industries, but the problem is magnified within the healthcare industry: "The population is aging, with the baby boom generation entering the age of increased need for health services"²⁵ the increased demand for health-related services will exacerbate the workforce shortage. The supply of healthcare workers will decrease due to retirement, and, as more people retire, the larger the demand for health-related services will result in a massive shortage and higher prices for consumers. Apart from the aging population, one of the most prominent reasons why the industry is facing a shortage is that there is a lack of instructors available to teach incoming nurses: "Staffing shortages are the main reason why nursing schools are not able to accept more students."²⁶ According to the dean of the University of Michigan-Flint, the nursing college association's statement that "Just under 8% of the teaching slots are vacant"²⁶ does not accurately reflect the shortage. She claims that it does not include part-time staff and clinical educators which play a vital role in educating students. The reason for this is little interest in becoming a nursing instructor part-time or the high opportunity cost. Nursing instructors are required to have their doctorate even for part-time work, but due to the relatively low wages, most doctorate holders choose to work in other positions that offer much higher pay. The earliest report expressing concern over the future of the workforce was published

in 2003 by Modern Healthcare, and it stated that “the average age of faculty members at nursing schools is 55 and administrators are finding it difficult to replace retiring instructors.”²⁷ The report also states that “[a]dditional federal funding is needed to help pay for more competitive faculty salaries.”²⁷ This shows that the lack of instructors and the issues behind it has been a concern for over a decade. As noted in the Mercer study, many lower-wage positions within the industry face a shortage, and, at the same time, these positions are also responsible for seeing the most patients. According to the School of Nursing of Duquesne University “primary care physicians who practice general internal medicine are in the highest demand (because they are the ones that see the most patients), the lack of qualified people in this area is especially problematic.”²⁸ General physicians are considered to be entry-level positions because, among those studying to be a doctor, they must first finish the certifications for a general physician; from there, they can choose to specialize within the field. The issue is that nearly all people choose to specialize in a higher paying career because it typically only requires an additional year or two, and they see less patients overall. The rapid growth in technology may also present a problem to the healthcare industry by inadvertently encouraging older nurses to retire early. New technologies, such as the “Electronic Medical Record (EMR) and other technological advances can also affect nurses staying in the profession.... Some seasoned nurses struggle with the technology and remove themselves from the profession at an earlier rate.”²⁵ As the healthcare industry implements newer and more complicated technology to their everyday tool kit, the technology literacy rate will fall among the older generation.

The shortage of nurses and other entry-level healthcare professionals puts additional strain on the incumbent workers to take on extra work compared to what they would be responsible for if their organization had the optimal level of employees. The extra work adds additional hours of high-stress workloads which damages the mental health of the workers. According to the University of Mississippi Medical Center, burnout is defined as:

a syndrome conceptualized as resulting from chronic workplace stress that has not been successfully managed. It is characterized by three dimensions: feelings of energy depletion or exhaustion; increased mental distance from one’s job, or feelings of negativism or cynicism related to one’s job; and reduced professional efficacy.²⁹

Excessive burnout deteriorates the quality of life and family relationships of workers and, in the case of the healthcare industry, can increase the rate of medical errors. In 2022, the U.S. Surgeon General published “Addressing Health Worker Burnout: The U.S. Surgeon General’s Advisory on Building a Thriving Health Workforce,” which discussed the effects of burnout among healthcare workers before and during the COVID-19 pandemic. The publication makes the distinction that burnout is not a problem that affects individuals but is something that is “a distinct workplace phenomenon that primarily calls for a prioritization of systems-oriented, organizational-level solutions.”³⁰ The publication states that the consequences of burnout within the healthcare environment are “decreased time spent between provider and patient, increased medical errors and hospital-acquired infections among patients, and staffing shortages.”³⁰ Not only

is burnout a factor in the workforce shortage but it also costs the economic sector over \$17 billion in annual burnout-related turnover costs.³⁰

4.3 Current Solutions

The solutions that the healthcare industry has attempted to address the shortage are more comprehensive when compared to the other industries. In the short term, hospitals have been hiring temporary works to fill in any of the gaps that they face despite the high costs associated in doing so; they have resorted to hiring “travel nurses, who go to different clinics or hospitals to fill temporary shortages.”³¹ This ensures that hospitals can serve more people and reduce the load on the current workforce, while the longer-term programs are increasing the future number of candidates. Currently, the number of people applying to nursing programs is increasing, but it has reached a bottleneck. The shortage of available instructors is limiting the future workforce. To solve this issue the “US Department of Health and Human Services announced in August that it will pump an additional \$26.5 million into the Nurse Faculty Loan Program, which provides low-interest loans to those studying to be nursing school faculty and the cancellation of up to 85% of loans for those who work as full-time faculty after graduation.”³² The program intends to increase the number of instructors to support the size of the future workforce by reducing the cost associated with reaching higher levels of education. The workforce shortage is not uniform across the country. The high population of cities and training programs within it attract more workers compared to rural areas. Rural areas often have an overall older population that require more health services making the lack of nurses there a major concern; so,

To assist in the recruitment and retention of professional nurses dedicated to providing health care to underserved populations, the Nursing Education Loan Repayment Program offers registered nurses substantial assistance to repay educational loans in exchange for service in eligible facilities located in areas experiencing a shortage of nurses.³³

Like the Nurse Faculty Loan Program, this program provides a financial incentive in exchange for taking on a certain position. In 2022, H.R.1667, the Dr. Lorna Breen Health Care Provider Protection Act, became law, establishing grants to fund activities that improve mental health among health care providers. The law specifically states that the “Department of Health and Human Services (HHS) must award grants to hospitals, medical professional associations, and other health care entities for programs to promote mental health and resiliency among health care providers.”³⁴ But more importantly “HHS must also study and develop policy recommendations on improving mental and behavioral health among health care providers, removing barriers to accessing care and treatment, and identifying strategies to promote resiliency.”³⁴ In 2024, HSS published their policy recommendation which created four strategic directions that should be implemented. HSS recommends the following strategic directions: Community-Based Suicide Prevention, Treatment and Crisis Services; Surveillance, Quality Improvement, and Research; and Health Equity in Suicide Prevention. Alongside their recommendations, HSS has also published a Federal Action Plan which proposes how they should implement their recommendations. The

Federal Action Plan states that “The Action Plan does not provide a comprehensive list of all suicide prevention efforts federal departments and agencies will conduct during the three fiscal years. Rather, it presents a set of priority actions to advance specific goals and objectives of the 2024 National.”³⁵ The Action Plan plans to achieve their goals, as set by *National Strategy for Suicide Prevention*, by collaborating with ten Federal departments and the twenty-six sub departments that are under the main ten. The HSS will release a monitoring and evaluation plan sometime in FY2024 which “will identify the fiscal year when each action will be implemented and indicate how agencies will monitor implementation and evaluate outcomes. Findings from ongoing assessments and emerging developments and priorities in suicide prevention will inform future action plans in subsequent years.”³⁵

4.4 Visa Based Solutions

Just like agriculture and the technology industry, the healthcare sector used to have a guest worker program known as the H1A visa program, but this was discontinued in the year 2000. The program was initially the H-1 visa program and allowed foreign workers to fill in any permanent position. From the H-1 program came the H-1A program which was created by the Nursing Relief Act of 1989. It allowed foreigners to seek temporary employment as nurses. A requirement of the program was that employers had to prove that the hiring of these foreign employees would not adversely affect the wages and protections of the domestic workforce, but the vast majority of the time they were placed in undesirable locations and work shifts, including in rural places which have a greater shortage of workers, so it was much easier to prove that there wouldn't be any adverse effects on the domestic workforce. The H-1A program showed the flaws of visa-based solutions; the creation of the program itself was a disincentive to the healthcare industry as it gave it no reason to invest in and create programs that focus on training more domestic workers as the government allowed the importation of a workforce. By the time the law was passed, the domestic workforce shortage was nearing its end. Once the program was discontinued, it was replaced with the H-1C program, but this was so restrictive that hardly any foreign nurses were allowed to apply, making it functionally pointless.

4.5 Interview

Many problems and solutions in the healthcare economic sector that were found in the literature review were confirmed in an informal interview with a member of the sector in California. The interviewee said that they observe a shortage across all segments of healthcare because healthcare needs are growing as a society in general. The shortage is particularly acute among less-skilled jobs, such as caregiving or nursing. The interviewee said that there is a slow rate of retaining newcomers to lesser-skills jobs because awareness of the shortage issue is low and marketing the need is not widespread. De facto solutions, such as contracting temporary work, is challenging because of the fundamental nature of the continuity of learning and exposure to healthcare skill development.

The interviewee said that the current workforce shortages are putting severe pressure on incumbent workers which is measured by the amount of overtime and the absence of a work/life balance within the economic sector. Potential solutions discussed by the interviewee include encouraging additional state and federal funding for investment in vocational training at private and public universities.

Summary & Conclusions

5.1 Recommendations

The current labor shortage in the highway construction industry needs to be addressed so that existing and upcoming projects can be completed, and California's transportation infrastructure can be reliable and efficient. Additionally, mental health issues are particularly acute in the construction workforce, and reducing the labor shortage has the potential to improve worker conditions.³⁶ Looking to comparative economic sectors that are facing or have faced similar labor shortages, there are potential solutions that address issues related to three main categories: (1) raising awareness of an increased demand for particular skills and positions, (2) recruiting workers with the proper skills, and (3) retaining quality workers so that positions remain filled. These three categories serve as an outline for the solutions synthesized from the lessons learned from the agriculture, technology, and healthcare sectors that follow.

The solutions most applicable to highway construction come from healthcare. Highway construction skills can be taught at trade schools and training programs led by experienced workers. Subsidized incentives can be put in place to recruit more teachers so that an instructor shortage does not develop like it has in healthcare. The instructors need to not only have the proper skills but also the ability to teach them and an incentive to move into a generally lower paying position.

Incentive programs for construction workers themselves can be a potential solution. Some of these solutions are in place as “[construction] firms have raised pay rates [and] 45 percent are providing incentives and bonuses and a quarter of firms (24 percent) have also improved their benefits packages.”³¹ Additional incentives could include reduced cost training programs in exchange for working some period of time in areas with shortages or at a specific company. Another solution already in place by at least one company is employer-sponsored training to be completed before hiring.

5.2 Highway Construction Hiring Process Checklist

Table 5 synthesizes the findings from the literature review and informal interviews into recommended steps to take when looking to hire for highway construction positions. Starting with a thorough hiring process and considering project labor agreements from the start will ensure longer retention of employees and help with the labor shortage on construction projects.³⁷

Table 5. Hiring and Retention Checklist for Highway Construction Economic Sector

Steps to anticipate when hiring for highway construction	Comment
1) Determine highway construction project start date	Do this before starting the hiring process so proper preparation can take place and there are no delays
2) Consider any existing project labor agreements	These may influence the terms of employment
3) Post job	Online job board, company website
4) Market job posting	Career social media, email listservs, prior contractors
5) Select interviewees	Select based on skills and experience Only select foreign workers if there is time to complete visa process prior to project start
6) Conduct interviews	Consider current skills as well as potential to upskill in available programs
7) Offer employment	Allow time for negotiation
8) Conditional: compile, submit, and wait for acceptance of visa paperwork for foreign/temporary workers	Allow for several weeks and provide resources or connect to resources that will assist with the legal process
9) Hold any necessary/required training	As determined by the construction or compliance needs
10) Highway construction project start date	Start the project once sufficient labor has been hired Ideally enough time was given prior to start date for sufficient hiring to take place
11) Ensure high job quality for duration of employment	Ensure compliance with worker standards Elicit and respond to feedback from workers on job quality Offer raises and benefit increases in response to economic changes such as inflation

5.3 Longer-Term Solutions

Table 6 summarizes the solutions that each economic sector has implemented to solve their workforce shortage. Each industry has unique challenges and constraints. Healthcare is primarily focused on increasing recruitment because that would also help them solve their retention issues. Awareness is a secondary concern. Agriculture is focused on retention and recruitment since they cannot find a way to make farmwork attractive to the public, and their incumbent workers are starting to retire. Technology is a large and diverse economic sector and has a broad set of issues, but because it requires the least manual labor amongst the three, many of the solutions are not as applicable to highway construction. The solutions highlighted in red indicate that the solutions cannot be applied to other industries. For example, it makes no sense to implement reducing the number of labor-intensive crops that are planted to the healthcare industry. The solutions highlighted in yellow are the solutions that are most likely to be a best fit for the highway construction industry. The remaining solutions may work for highway construction, but they may not be as effective or would require major changes to be implemented.

Table 6. Industry Solutions

	Agriculture	Technology	Healthcare
Raising awareness		Early career programs	
Recruitment	Visa programs Higher wages	Visa programs Loosening degree restrictions	Travel Nurses Nurse Corps Loan Repayment Program
		Creating own Training Programs	Nurse Faculty Loan Programs
Retention	Reducing Labor intensive crops Technological investments	Upskilling workers	H.R.1667

The healthcare sector has created two programs that address the mismatch between the shortage of available healthcare workers in some areas of the United States versus areas that have a surplus of available workers. In “A State by State Look at the Construction Labor Shortage” from Construction Executive, it was found that California, Massachusetts, and New Jersey have the greatest severity of workforce shortages in the construction sector.³⁸ This shows that some areas of the United States have a greater need for construction workers than others. A similar federal program that is tailored to the construction industry could fund the training of incoming construction workers in exchange for relocating workers to areas with critical projects that are facing a labor shortage.

In the longer term, members of the highway construction sector can propose a program for foreign workers that is similar to the H-2A program for agriculture. This may be possible due to the cyclical nature of the sector, similar to agriculture, but the administrative costs associated with the program would need to be subsidized so they can be afforded by more than just the largest companies. Focusing on the future supply by implementing training programs is likely the best option, as well as the creation of talent pipelines.

Additional research can further investigate the shortage in highway construction and any findings can be used to amend or edit the hiring and retention checklist as the issue evolves. Maintaining a proactive approach is more effective than responding to labor needs reactively and can ensure that enough workers with the proper skills are in place to meet the growing demand of infrastructure projects. An interdisciplinary forum that convenes members of different economics sectors that have dealt with labor shortages would offer a means of sharing lessons learned and potentially mitigating future shortages.

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Dr. Thomas O'Brien is the Associate Dean of the College of Professional and Continuing Education (CPaCE) at California State University, Long Beach (CSULB) and the Deputy Director of Long Beach Programs for the METTRANS Transportation Consortium, a partnership of CSULB and the University of Southern California. He also serves as the Director of the FHWA Southwest Transportation Workforce Center (SWTWC). He previously served as the Executive Director of the Center for International Trade and Transportation (CITT) at CSULB). Dr. O'Brien is an instructor in CSULB's Master of Science in Supply Chain Management (MSSCM). Dr. O'Brien is a member of the Executive Committee of the Council of University Transportation Centers (CUTC) where he served as president and is a member of the CUTC Workforce Development Taskforce and Chair of the oversight committee of the National Science Foundation's National Center for Supply Chain Technology Education. He is a member of the Transportation Research Board's Intermodal Freight Transport Committee and Urban Freight and Operations Committee. He also serves on the Boards of the Southern California Roundtable of the Council of Supply Chain Management Professionals, Los Angeles Transportation Club, Foreign Trade Association and National Transit Institute. Dr. O'Brien has a Master's degree in Urban Planning and Development and a Ph.D. in Policy, Planning, and Development from the University of Southern California. He is both an Eno and Eisenhower Transportation Fellow.

Ben Olson

Ben Olson is the GIS and Data Manager at the Center for International Trade and Transportation (CITT) at California State University, Long Beach (CSULB). At CITT, Ben manages the center's GIS projects and research responsibilities. He leads to the development of GIS applications and their integration into training programs for working professionals and K-12 audiences. Ben received his Master's in Geographic Information Science from CSULB and Bachelor's in Statistics and Spanish from the University of Illinois, Urbana-Champaign (UIUC).

Devin Martinez-Flores

Devin Martinez-Flores is a Research Associate for the Center for International Trade and Transportation (CITT) at California State University, Long Beach (CSULB). As a research assistant Devin works with lead researchers to ensure projects are completed on time. Devin has worked on projects focused on reducing truck congestion through Intelligent Transportation Systems and workforce development toolkits. Devin received his Bachelor's in Business Economics from CSULB.

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