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INDIANA DEPARTMENT OF TRANSPORTATION
AND PURDUE UNIVERSITY



An Assessment of the Workforce and Occupations in the Highway, Street, and Bridge Construction Industries in Indiana



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16. Abstract This project explores workforce and occupations within the highway, street, and bridge construction industries (NAICS 237310) in Indiana. There are five specific deliverable comprised of three data reports, one policy document, and a website. The first data report includes an assessment of the workforce based on the eight-part framework, which are industry, occupations, job postings, hard-to-fill jobs, Classification of Instructional Programs (CIP), GAP Analysis, compatibility, and automation. The report defines a cluster followed by a detailed analysis of the occupations, skills, job postings, etc., in the NAICS 237310 industry in Indiana. The report makes use of specialized labor market databases, such as the Economic Modeling Specialists International (EMSI), CHMURA JobsEQ, etc. The analysis is based only on the jobs covered under the unemployment insurance or the Quarterly Census of Employment and Wages (QCEW) data. The second data report analyzes jobs to jobs flows to and from the construction industry in Indiana, with a particular emphasis on the Great Recession, by utilizing the Bureau of Labor Statistics (BLS) data. The third data report looks into the equal employment opportunity or Section 1391 and 1392 data for Indiana and analyzes specific characteristics of that data. The policy report includes a set of recommendations for workforce development for INDOT and a summary of the three data reports. The key data on occupations within the NAICS 237310 are provided in an interactive website. The website provides a data dashboard for individual INDOT Districts. The policy document recommends steps for development of the highways, streets and bridges construction workforce in INDOT Districts.			
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EXECUTIVE SUMMARY

Introduction

This report includes findings and takeaways from the three data analysis reports and workforce development policy report prepared for the Indiana Department of Transportation (INDOT) by a team from the Purdue Center for Regional Development. The deliverables for SPR-4446 include workforce analysis for NAICS 237310 (highway, street, and bridge construction industry) from the perspective of industry, occupations, job postings, hard-to-fill jobs, classification of instructional programs (CIP), compatibility, GAP analysis, and automation. Two additional data reports examined jobs-to-jobs flows to-and-from the construction industry, as well as equal employment opportunity data obtained from the FHWA and INDOT. All data analyses were conducted for covered jobs or QCEW (Quarterly Census of Employment and Wages) using unsuppressed jobs data from economic and labor market databases. The state of Indiana and INDOT districts serve as the geographic focus of this study. The workforce development policy report is based on research literature, secondary data analysis, and discussions held with key informants from Departments of Transportation in Colorado and Florida who have workforce development expertise. Finally, an online data dashboard showcasing select data for individual INDOT districts is produced. The dashboard includes statistics for each INDOT District on occupations and staffing patterns within the NAICS 237310.

Findings

The highway, street, and bridge construction (NAICS 237310) industries in Indiana have value chain linkages with mining (e.g., sand and gravel) and durable manufacturing (e.g., asphalt, concrete, prefab, and structural metals). Furthermore, the sector has economic connections with long distance freight, construction equipment rental and maintenance, and professional engineering services.

The NAICS 237310 industries fared better during the Great Recession (2008–2009) despite declines witnessed in other construction industries. The post-recession recovery was faster and, in general, maintained a year-by-year LQ (location quotient) of 1.0 or higher—a reflection of the competitive nature of the industry.

The staffing patterns for NAICS 237310 reveal that its major occupational grouping is construction and extraction jobs followed by transportation and material moving, which together constitute 80% of all jobs in this sector. At the most detailed level, construction laborers have the largest number of jobs, followed by operating engineers and other construction equipment operators, heavy and tractor-trailer truck drivers, and first-line supervisors of construction trade and extraction workers. Each of the six INDOT districts has the same top two occupations—construction laborers and operating engineers and construction equipment operators—although subtle differences in the occupational makeup and staffing patterns exist within the NAICS 237310 industry.

Hard-to-fill occupations are in high demand but difficult-to-fill in the labor market. These include surveyors; civil engineers; health and safety engineers (except mining); truck drivers; freight stock and material movers; various first line supervisors; and a variety of mechanics, maintenance, and repair workers. Each of the six INDOT districts shows an anticipated GAP or an under-supply of truck drivers, mechanics, equipment operators, masons, carpenters, etc., in the next five years.

CIP analysis documents the existence of large gaps between program completion and openings in such occupations as

surveyors, mobile heavy-equipment mechanics, heavy and tractor-trailer truck drivers, etc. However, compatibility analyses are undertaken for occupations with the most severe supply/demand gaps, such as surveyors; industrial safety and health engineers; maintenance and repair workers; and heavy equipment mechanics. At the same time, an automation analysis reveals that some occupations with higher gaps are at risk of being automated in the future. Both compatibility and automation analyses are informative in guiding the development of talent pipeline and workforce supply chain strategies.

Jobs-to-jobs flow analysis reveals that moderate flows of construction workers to and from Indiana to specific states, such as Illinois, Ohio, Michigan, Kentucky, and Texas, occurred during the Great Recession (2008–2009). Administrative, support, waste management, and remediation services sectors experienced the largest exchange of workers with the construction sector.

Analysis of Equal Employment Opportunity reveals that occupational categories of Section 1391 and 1392 data may be outdated since they fail to align with existing Bureau of Labor Statistics (BLS) Standard Occupation Classification (SOC) categories. In addition, the compilation of race and ethnicity information departs from the U.S. Census Bureau's classification. This makes analysis of racial and ethnic diversity in the highway, street, and bridge construction industry workforce challenging.

Implementation

It is recommended that INDOT invest resources on an annual basis to maintain the interactive online website and incorporate critical new data on occupations and staffing patterns for every district. The data analysis activities and workforce policy assessments being pursued by some other state DOTs make it clear that INDOT districts should avoid pursuing a one-size-fits-all workforce development strategy. Rather, a workforce development plan that is tailored to the unique workforce needs of each district should be embraced. Simply put, the blend of occupations, staffing patterns, and magnitude of gaps in supply and demand should be carefully examined on a district-by-district basis.

It may be worthwhile to invest in a workforce development pilot effort in one district based on the recommended steps and partners suggested in our workforce policy report. This would include the active involvement of key stakeholders, community representatives, and institutional partners/collaborations who could serve in an advisory role for the district. Equally important would be the pursuit of more robust evaluation strategies since existing data collection methods—such as Section 1391 and 1392—are not sufficient to achieve diversity and gender equity goals.

Other implementation recommendations being proposed include the following:

- Integrate and implement a general career pathway for vital construction sector, including employment training and ways to deploy it.
- Provide opportunities that encourage and foster a regional approach within each INDOT district—one tailored to the unique workforce recruitment and development needs of each district.
- Develop a network of support services that can be tapped across INDOT districts. These resources could be crucial to the retention of INDOT's newly trained workforce.
- Coordinate efforts to diversify Indiana's construction workforce. This would involve outreach to trade groups with active outreach to minorities, women, people with disabilities, and veterans.

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1. INDOT HIGHWAYS, STREETS, AND BRIDGES CONSTRUCTION WORKFORCE POLICY RECOMMENDATIONS

The Purdue Center for Regional Development lays the groundwork and basis for a better, more inclusive transportation construction workforce. This report was guided by PCRD data products, research on transportation workforce, and conversations with other state DOTs. Overall, an investment in the road construction workforce, in conjunction with the state’s broader construction industry, would maximize the re-investment of INDOT project dollars back into the state economy by fostering the employment of residents in workforce opportunities.

We propose that INDOT give primary attention to investing and building a statewide workforce to fill the construction labor shortage in Indiana. Doing so will generate a positive impact on the labor shortage through a concentrated program to upskill and uplift Indiana’s workforce. As such, the following recommendations are designed to address the labor shortages that currently exist and alleviate gaps in the streets, bridges, and highways workforce in the future. Worth noting is the interdependent and sequential nature of these policy strategies. Collectively, they are intended to offer INDOT a blueprint for launching a robust workforce development program over the next five years which, ultimately, will reduce the cost of contractors. It is recommended that INDOT use its five-year project timeline and integrate both the workforce data and these complementary policies to effectively plan for the future.

The following three policies provide a response to specific data reports (see Figure 1.1). NAICS 237310 industry sector (highway, street, and bridge construction) shares multiple supply and buyer chain linkages. The related sectors include manufacturing such as durable products (wood products, prefabricated metal etc.), and mining and transportation sectors. As NAICS 237310 has cross-sectoral linkages to other industries, it would require a collaborative approach among all key sectors to address the employment gaps. Support from the American Recovery and Reinvestment Act likely

generated more resilience in the highway, street, and bridge construction industry as it experienced less volatility overall. As Indiana enters its next economic volatility, a concerted effort and further reinvestment from stakeholders at the state level would continue the resiliency legacy following the pandemic shockwave.

In the short-term, public investment in infrastructure may have a positive effect on the economy at the regional level after a shock. The immediate employment and deployment of a trained workforce into reprogrammed projects may mitigate the economic impacts (Wolman et al., 2017). Having a skilled workforce is a critical need for the transportation industry. Factors contributing to a workforce shortage in this industry include retiring workers from the baby boom generation, industries competing for the same skills, and enhanced skills needed for new technologies, such as automation (Martin & Dudley, 2017). A workforce survey conducted in 2019 found that 80% of contractor respondents stated they had difficulty finding qualified workers in the U.S.; 81% of contractor respondents from the Midwest reported similar levels of difficulty (Associated General Contractors of America & Autodesk, 2019).

In this context, the overarching policies presented in this report are identified in Figure 1.1.

1.1 Policy #1: Collaborate Across Sectors, Nonprofit Organizations, Industry Partners, and Key State Agencies

Develop a state-level advisory committee that is driven initially by INDOT, but gradually transition to an industry-led committee. This committee will seek to collaborate and not duplicate methods across the construction sector as a whole. The committee will be tasked with the following over the next several years:

1. Scope potential district INDOT locations for a pilot program.
 - a. Focus on a district with an acute labor shortage in most construction.
 - b. Determine the number of new positions created and how many will need construction-based training.
 - i. Evaluate costs to implement.



Figure 1.1 Visualization of policies 1–3.

- c. Choose a district based on timeline of projects over the next 5 years which is large in scope.
 - i. Determine costs and funding needs.
 - d. Select a district that welcomes cross-collaboration among state and industry partners.
2. Reach agreement on a general training pathway for all on-site labor in both construction, trades and road labor careers.
 3. Establish and manage an industry-led regional taskforce (consisting of local organizations) to implement and oversee workforce development in a pilot district.

1.2 Policy #2: Identify and Secure Funding

Identify potential funding sources for workforce development and wrap-around support services. Consult with advisory committee members on the best approaches for seeking funding from organizations, community foundations and other government entities to fund training scholarships. Investigate private foundation funding sources, use PCRD data to write proposals and build case for workforce investment.

1.3 Policy #3: Align Advisory Committee Resources

Align advisory committee resources around several objectives at the state level.

1. Integrate and implement a general career pathway for vital construction sector, employment training and how to deploy it. Provide opportunities that encourage and foster a regional approach within each INDOT district, one tailored to the unique workforce recruitment and development needs of each district.
2. Future interagency partnerships along with the alignment of economic, community, and infrastructure projects with local workforce investment will compound to produce positive, collective impacts.
3. Coordinate efforts to diversify Indiana’s construction workforce. This would involve outreach to trade groups who serve minorities, women, people with disabilities, and veterans.
4. Consider developing a workforce pipeline in conjunction with high schools and their respective career academies.
5. Secure funds to subsidize OTJ and apprenticeship wages paid by the contractor, ensuring trainees are earning money while gaining valuable job skills.
6. Position the Advisory Committee to help advocate for the training needs with various foundations and possible partners.
 - a. Urge advisory committee members to network as much as possible and advocate for construction-sector, cross-partner training.

7. Implement a training program which contains the following components:
 - a. *Week 1: Construction Safety*
 - i. OSHA construction 10
 - ii. First aid/CPR
 - iii. Construction math and measurement
 - b. *Week 2: Workplace Skills*
 - i. Plan/print reading
 - ii. Erosion control
 - iii. Team building and communication
 - iv. Hand and power tool safety
 - v. Material handling and forklift safety
 - vi. Flagger training and certification
 - c. *Week 3: Capstone Examples.* Students could choose one of the following types of additional training:
 - i. Heavy equipment
 - ii. Concrete work
 - iii. Welding
8. Develop and offer specialized training from partner facilities based on district level workforce labor shortages.
9. Identify partner organizations to sponsor candidates with no experience to work on INDOT projects.
10. Identify training requirements for each trade and consider holding a workshop for interested job candidates to explore possible careers.
11. If COVID-19 remains an impediment to training, consider initiating e-learning resources with community partners.

Once objectives 1 through 3 have been reached, INDOT could pilot the program within one district rather than statewide (see Figure 1.2). The steps to this process are described below.

1.4 Policy #4: District Workforce Implementation

Develop a network of support services that can be tapped across INDOT districts. These resources will be crucial to the retention of INDOT’s newly trained workforce. This policy seeks to address some of the barriers that streets, bridges, and highway workforce face which negatively impact their job retention. An advisory committee may be formed with district level representation from the community level such as regional planning bodies, county economic development partners, non-profits and other community development organizations.

1. Secure funding to help streets, bridges, and highway workforce access an array of services and resources with community organizations the grassroots level.
 - a. A stabilization fund would allow the new workforce to acquire tools and personal protection equipment in order to conduct their jobs.

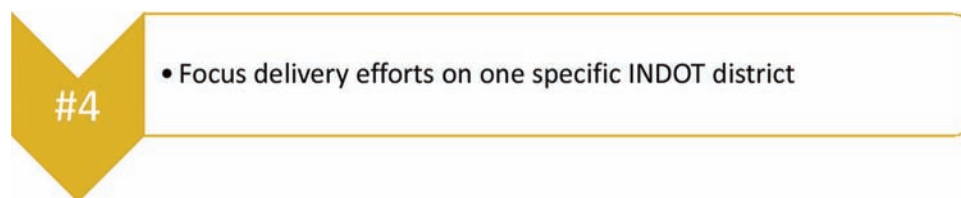


Figure 1.2 Visualization of Policy 4.

- b. Internet hotspot funding would also help rural and remote workers complete their e-learning training and communicate with their supervisors.
 - c. Provide transportation vouchers. These would allow members of the workforce to come to work in the event that their regular mode of transportation is temporarily unreliable. Professional dues and fees could also be paid by a secured fund.
 - d. Coordinate with agencies that provide access to food pantries.
 - e. Identify child care providers in the region that operate outside normal business hours. Offer child care vouchers to employees and their families.
 - f. Create a directory of services for all new trainees, apprentices, and contractors working on INDOT projects.
2. Identify and establish a strong network of relationships among social service providers with a pilot district in order to roll out recruitment and support services.
 3. With secured workforce funding, develop a website on the street, bridge, and highway recruitment program and efforts. Applicants should be able to search and apply for construction positions. The website should advertise secured state, foundation, city and regional partnerships. Create recruiting materials for contractors, potential recruits. Highlight your program's successful metrics on a program website and promotional material.
 4. Scale up and implement in other districts once INDOT has achieved success.

2. AN ASSESSMENT OF THE WORKFORCE AND OCCUPATIONS IN THE HIGHWAY, STREET, AND BRIDGE CONSTRUCTION INDUSTRIES IN INDIANA (SPR-4446 JTRP AND INDOT)

This is a summary of the three data products developed for the SPR-4446 (*An Assessment of the Workforce and Occupations in the Highway, Street, and Bridge Construction Industries*) funded by the Joint Transportation Research Program (JTRP) and Indiana Department of Transportation (INDOT). The study area is the state of Indiana and INDOT districts. The data are for the year 2018 and based on the Quarterly Census of Employment and Wages (QCEW) compiled by the Bureau of Labor Statistics (BLS). The focus of the research is on NAICS 237310 (highway, street, and bridge construction industry), which is a six-digit industry sector and hence, the data might be suppressed for some rural counties. The Purdue team tapped Economic Modeling Specialists International (EMSI) proprietary data to obtain unsuppressed jobs numbers and staffing pattern occupations pertaining to NAICS 237310, as well as information from the CHMURA JobsEQ model. Both U.S. Census Bureau and FHWA data were used for the other two reports.

1.5 Policy #5: Establish, Track, and Benchmark Key Employment Accomplishments by Quarter

These metrics are key to providing evidential support for workforce development programs in addition to the recruitment and retention of potential workforce, contracting partners and resource support services.

1. Find and prepare workers with the help of key partners.
 - a. Number enrolled in training
 - b. Ratio of males to females
 - c. Number of new apprenticeships and their average starting wages
 - d. Number of new placements
 - i. Industry employment rate among job seekers overall
 - ii. General employment among all job seekers
 - e. Number of incumbent workers
 - f. Graduate job opportunities and average wages
 - i. General laborer wages
 - ii. Labor, trade, and craft trainee wages
 - iii. Average wages on INDOT projects
2. Integrate and scale supportive services for the workforce.
 - a. Number of cross-agency partner referrals
 - b. Amount (\$) of support services allocated
 - c. Percentage of workers who accessed supportive services
 - i. Percentage of workers who accessed different types of support services
3. Identify and remove barriers to employment.
 - a. Percentage of workforce whose income increased in the past 6 months

2.1 First Data Report: Workforce Characteristics

The first data report focuses on workforce characteristics of the NAICS 237310. The Purdue Center for Regional Development (PCRD) has been exploring a workforce analysis framework comprised of eight themes: *industry, occupations, jobs postings, hard-to-fill jobs, classification of instructional programs (CIP), compatibility, GAP analysis, and Automation*. These topical areas provide the demand and supply perspectives for the workforce and occupations.

2.1.1 Industry

The industry section provides a glimpse into the cluster or supplier and buyer chain relationships of the highway, street, and bridge construction industry in Indiana. This sector has value chain linkages with various industries in mining, such as sand and gravel, and durable manufacturing, such as asphalt, concrete, prefabricated and structural metal. The sector also has linkages with long-distance freight, various construction and industrial equipment rentals, maintenance, and professional engineering services among others.

The highway, street, and bridge construction industry in Indiana did not experience severe setbacks during the Great Recession (2008–2009) as observed in other sectors of the economy, and the post-recession recovery

was faster. This could be due to federal grants, such as the American Recovery and Reinvestment Act (ARRA) of 2009 and state funded construction projects underway in response to the recession. The industry retained an LQ (location quotient) of 1.0 or higher during and after the recession period of 2008–2009. Similarly, establishments within NAICS 237310 industry that declined during the recession have been increasing in the post-recession period.

2.1.2 Occupational Analysis

The occupational analysis looks into the staffing patterns of the highway, street, and bridge construction industry. Occupations related to construction and extraction, which is the Standard Occupational Classification (SOC 47), provide nearly 69% of jobs in 2018. The second largest occupations group is the transportation and materials moving (SOC 53) providing nearly 11% of jobs in this sector. Together, both occupation groups provided 80% jobs in the highway, street, and bridge construction industry in 2018. At the most detailed SOC five-digit level, the top occupation was construction laborers (1,976 jobs) followed by operating engineers and other construction equipment operators (1,141 jobs) in 2018. Heavy and tractor-trailer truck drivers (537 jobs) and first-line supervisors of construction trade and extraction workers (515 jobs) ranked third and fourth, respectively.

Within the top 15 occupations in highway, street, and bridge construction industry, very few occupations required a bachelor's degree as the typical entry-level education. These include construction managers, general and operation managers, and cost estimators. The remainder of the top 15 occupations had a high school or associate degree as the requisite level of education. As for the distribution of workers by gender, construction laborers and operating engineers and other construction equipment operators have very small percentages of female employees. Moreover, the jobs have higher proportions of workers of prime working age (25–54 years old) compared to the state average. Occupations that have a share of Hispanic workers that exceeded or matched the state average were construction laborers, cement masons and concrete finishers, carpenters, and structural iron and steel workers. Each of the six INDOT districts—Greenfield, Crawfordsville, Vincennes, Fort Wayne, LaPorte, and Seymour—has construction laborers and operating engineers and other construction equipment operators as the top two occupations. The third, fourth, and fifth ranked occupations varied between paving surfacing and tamping equipment operators, first-line supervisors of construction trades and extraction workers, heavy and tractor-trailer truck drivers, cement masons and concrete finishers, and carpenters. There are subtle differences in occupational makeup and staffing patterns in the highway, street, and bridge construction industry within the six INDOT districts. This warrants that

workforce development programs need to be tailored for each INDOT District.

2.1.3 Job Postings

Job postings provide an assessment of real-time demand for various job titles within the highway, street, and bridge construction industry in Indiana. From January 2017 to December 2019, the EMSI model retrieved 7,292 job postings with 2,131 unique job postings in Indiana. The data report provides additional metrics, such as average active postings, unique postings, and posting intensity. The top job titles by posting intensity or effort employers are making to recruit talent include maintenance mechanics, engineers, quality inspectors, forklift operators, commercial driver's license holders, regional truck drivers, etc. Flatbed truck operation, sales operation, quality control, and production equipment are some of the hard skills where the demand exceeds available supply, according to the EMSI data. Similarly, detail oriented, problem solving, organization skills, and communications are some of the soft skills where demand exceed the supply in the labor market. Top certifications and qualifications mentioned in the job postings include various commercial driving licenses, certification for forklift operation, safety procedures, traffic control, etc. Top occupations requiring an associates or high school education comprised of maintenance and repair workers, industrial truck and tractor operators, various types of first-line supervisors, general production workers, industrial engineering technicians, etc. Note that the job postings data are retrieved from various online postings and job boards. Hence, construction laborers are not included because recruitment for these jobs tends to happen through person-to-person, word by mouth, and informal referrals. Some of the top occupations requiring a bachelor's or a higher education include cost estimators, civil engineers, construction managers, industrial production managers, book-keeping, accounting and auditing clerks, etc.

2.1.4 Hard-to-Fill Jobs

Hard-to-fill jobs is a specific analysis of job postings based on unique postings and duration-to-fill information. High demand and slow-to-fill are the occupations that have unique postings and duration-to-fill that are greater than the median values. This means that employers are striving hard to fill-in the positions and hence, rely on multiple postings of these jobs. At the same time, these vacancies are taking longer than the median number of days to recruit individuals. Those deemed to be of high demand but slow-to-fill occupations include surveyors, civil engineers, health and safety engineer except mining, etc., in architecture and engineering (SOC 17); heavy, light, and industrial truck drivers, traffic technicians, freight, stock and material movers, etc., in transportation and material moving (SOC 53); and various first line supervisors, a variety of

mechanics, maintenance and repair workers, etc., in installation, maintenance, and repair (SOC 49).

2.1.5 GAP Analysis

GAP Analysis is a methodology to forecast demand and supply gaps for top occupations in the staffing patterns. We employed two models (EMSI and CHMURA Jobs EQ) to assess the gaps in top occupations in highway, street, and bridge construction industry in each of the six INDOT districts. The process provides a five-year forecast of either a GAP or a SURPLUS in top occupations in the staffing patterns after accounting for various labor market dynamics, such as growth, new hires, retirement, displacement, replacement, deaths, etc. Positive numbers indicate annual surplus whereas negative numbers indicate annual gap in the occupations.

Each of the six INDOT districts show gaps or under supply of top occupations, such as truck drivers, mechanics, equipment operators, masons, carpenters, etc., specific to the highway, street, and bridge construction industry in the next five years. A GAP means that the district might have to import workers from outside. Whereas forecasts depend on assumptions and limitations of the models, the data indicate that there are chances of under-supply or gaps in major occupations within the highway, street, and bridge construction industry in INDOT districts.

2.1.6 Classification of Instructional Program (CIP)

Classification of Instructional Program (CIP) analysis provides supply perspective to the occupations by tracking recent graduates who are new entrants to the labor market. The method uses a crosswalk between instruction programs and occupations—or CIP to SOC bridge. The CIP analysis focuses on hard-to-fill occupations, corresponding programs, openings and completions in Indiana. The large gaps between number of openings and completions in surveyors, mobile heavy equipment mechanics, heavy and tractor-trailer truck drivers, etc., can be observed from the table. The CIP analysis also provides institutions in Indiana providing the relevant educational programs.

2.1.7 Compatibility Assessment

Compatibility assessment is one way of expanding the supply of skilled labor force into an industry. Compatible occupations are those in which a person can move from one occupation to another with minimal amount of training required. When the gap between demand and supply cannot be filled-in from new incoming labor force or experienced labor force, industries look for retraining and retooling of those in the existing workforce engaged in compatible occupations to help fill the gaps. Compatibility scores are based on matching of skills and tasks needed to perform a particular job. It is also used for career pathway assessment and prospects.

We have provided highly compatible occupations for select occupations within the highway, street, and bridge construction industry with higher gap levels. For example, geodetic surveyors, surveying technicians and several occupations have compatibility scores of 90 or above who can perform the job functions of a surveyor. Similarly, industrial safety and health engineers have several occupations with higher compatibility scores of 90 or above, such as occupational health and safety specialists and environmental compliance inspectors. The data report also provides compatible occupations for general maintenance and repair workers and mobile heavy equipment mechanics. Compatibility scores can be helpful for job switching from occupations with surplus labor force to occupations with gaps in labor force with minimal training. The workers have the incentive for higher wages in occupations with a tight labor market. Note that compatibility scores utilize Occupational Information Network (O*Net) characteristics.

2.1.8 Automation

Automation, computerization, digitalization, etc., are trends pervading every type of industries, and the highway, street, and bridge construction industry is not exempt from these shifts. However, the degree of automation depends on the staffing patterns and occupations within the specific industry sector. We have used automation indices developed by the EMSI, which builds on seminal research on automation of occupations by Frey and Osborne (2017). The probability of automation depends on the share of routine and repeatable tasks within an occupation. The report provides automation indices of top occupations in each of the six INDOT districts. Construction laborers that are the largest in numbers also have the highest automation index of 132. An index value of higher than 100 means the occupation has above average probability for automation. Heavy and tractor-trailer truck drivers that have such high demand versus supply gaps have an automation index of 110. It means the tasks performed by this occupation can be automated easily. Where demand and supply gaps exist within occupations in the highway, street, and bridge construction industry, upcoming automation trends may very be able to fill those gaps.

2.2 Second Data Report: Job-to-Job Flows

Our second data report looks into Job-to-Job (J2J) flows in Indiana's construction industry. J2J flows is a matched employer-employee database providing flow of workers into and out of the construction industry sector in Indiana. For this study, we focused on the Great Recession (2008–2009) period to answer questions such as what happened to construction workers during this period of economic unrest? Where did they move to? Where did they come from? What kinds of worker flows happened among various industry sectors? Note that J2J flows database is part of the

Longitudinal Employer-Household Dynamics (LEHD) program of the U.S. Census Bureau. The data are limited to NAICS two-digit and as such, we focused on the construction sector (NAICS 23). Despite this limitation with respect to the level of aggregation, J2J provides valuable insights into worker dynamics or “churn” happening within the labor market.

During the Great Recession, the construction sector experienced a major setback with respect to job losses. The exception was highway, street, and bridge construction industry (NAICS 237310), which fared better in Indiana because of federal stimulus and state programs (as noted in the first data report). The 2008–2009 recession was difficult on the real estate sector, especially the housing market, which had a significant spillover effect on other industries. Hence, other types of construction, such as residential and office construction activities, took a disproportionate hit during the recession. This caused workers to move from construction to other industries. At the same time, workers from other industries moved into the construction sector. From 2008 Q1 to 2009 Q4, around 23,262 workers moved out of construction to other industries, whereas 22,814 workers moved into construction from other industries. Indiana attracted most of the other industry workers moving into construction from Illinois and vice versa. Similarly, the top origin industry for moving into construction was administrative, support, waste management and remediation services sector and vice versa.

The top five destination states for construction workers from Indiana included Illinois, Kentucky, Ohio, Michigan, and Texas. The top five destination sectors included administrative, support, waste management and remediation services, manufacturing, retail trade, accommodation and food services, and wholesale trade. The top five origin states and industry sectors from where workers moved into construction in Indiana were also the same. While a large number of workers moved within the construction industry sector, the industry-to-industry and state-to-state dynamics were not insignificant. The data report covers other indicators of workforce dynamics, such as hires, separations, and earnings before and after job switch.

2.3 Third Data Report: Equal Employment Opportunity Trends

The third data report explores Section 1391 and 1392 records that are part of the annual *Equal Employment Opportunity (EEO)* documentation obtained from the Federal Highway Administration (FHWA) for Indiana. The worker’s data are collected from contractors engaged in federal aid projects in Indiana during one-

week period in July that is considered the prime *construction peak period*. The survey collects specific information, such as gender, race, and ethnicity for select 15 occupational categories or job titles. In our research, we were able to match Section 1392 job categories with SOC two-digit occupations with only a few exceptions.

Construction and extraction occupations comprised nearly 59% jobs in 2019. From 2010 to 2019, the share of minority in total workforce increased from 12% to 19.1%, respectively. However, the definition of minority includes Blacks, Asians, Native Americans, Pacific Islanders, two or more races, and Hispanics. The data are compiled in such a way that race and ethnicity cannot be estimated separately, making it different from U.S. Census Bureau and other public data. The survey collects the gender information for each race and ethnicity category. From 2010 to 2019, female gender increased marginally from 8.5% to 9.1%, respectively.

The annual survey collects information on trainees and apprentices. From 2010 to 2019, total number of trainees and apprentices increased from 635 to 816, respectively. Some years, such as 2015 observed 973 trainees and apprentices while the numbers in 2018 grew to 1,002. Overall, the annual EEO survey data revealed similar trends as observed in the first data report based on the BLS, EMSI, and CHMURA JobsEQ. The top five jobs, by the total number of workers, included semi-skilled laborers, equipment operators, unskilled laborers, supervisor, and clerical workers. The top five job categories covered 70% or more of the total workers from 2010 to 2019. Additionally, annual projects and values were provided that enabled us to estimate productivity or value per worker over the 2010 to 2019 period.

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About the Joint Transportation Research Program (JTRP)

On March 11, 1937, the Indiana Legislature passed an act which authorized the Indiana State Highway Commission to cooperate with and assist Purdue University in developing the best methods of improving and maintaining the highways of the state and the respective counties thereof. That collaborative effort was called the Joint Highway Research Project (JHRP). In 1997 the collaborative venture was renamed as the Joint Transportation Research Program (JTRP) to reflect the state and national efforts to integrate the management and operation of various transportation modes.

The first studies of JHRP were concerned with Test Road No. 1 — evaluation of the weathering characteristics of stabilized materials. After World War II, the JHRP program grew substantially and was regularly producing technical reports. Over 1,600 technical reports are now available, published as part of the JHRP and subsequently JTRP collaborative venture between Purdue University and what is now the Indiana Department of Transportation.

Free online access to all reports is provided through a unique collaboration between JTRP and Purdue Libraries. These are available at <http://docs.lib.purdue.edu/jtrp>.

Further information about JTRP and its current research program is available at <http://www.purdue.edu/jtrp>.

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