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Factors impacting skilled construction labour shortage in Michigan

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Abstract: Decades of decline in skilled trade labour require an urgency of addressing this trend. This study investigates Michigan's skilled construction labourer (SCLs) shortage through three overarching questions: what factors influence and cause this shortage; how are stakeholders responding; and what innovative solutions could reverse this trajectory. A review of the literature revealed recruitment difficulties due economic volatility, skill deficiencies, and perceived lack of advancement. Based on these factors and others, two surveys were conducted to study opinions of construction managers and skilled trade labourers mostly in Southeast Michigan by analysing demographics across different categories using analysis of variance (ANOVA). The results not only corroborated the importance of vocational training but also added to the body of knowledge details that were not previously investigated. The results indicate that exposure to vocational education at high school increased the likelihood of seeking vocational training before joining the industry from 2.6% to 29%, and internships played a major role in training union workers. However, project managers (PMs) preferred recruiting workers from internships and on-the-job training over trade schools and unions. The young workers had mixed expectations of remaining in the industry until retirement compared to those over 40 years of age. The methodology utilised in this study can help the construction industry in the United States and elsewhere to identify areas of improvement to attract more workers into the field, and the findings of this study are particularly useful to construction companies in Michigan in determining where they need to focus their efforts to improve training and recruitment.

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1 Introduction

Economists warn of a continuing, national labour shortage across all industries (Maurer 2023). Relatedly, Michigan's declining population, among other factors, is further contributing to its diminishing workforce. Within the next 10 years, approximately 15% of Michigan's 10 million residents will reach their retirement age, and 25% of surveyed, young adults aged 18–29 years (approximately 340,000) plan to move to progressive cities in other states (Business Leaders for Michigan 2023). With these statistics, Michigan is on track to lose 18% of its overall workforce this decade.

The 2002 bipartisan No Child Left Behind Act (NCLB) led to a stigma that success could only be achieved through a college education (Terpstra 2023). For over two decades, testing of academic achievement was prioritised, limiting children's exposure to skilled trades. The pandemic resulted in declines in mathematical test scores of Michigan students in the eighth grade (National Center for Education Statistics 2022), leaving questions regarding their post-graduation readiness for construction apprenticeships and vocational training. Negative perceptions of the career inhibit potential recruits from considering careers in the construction trades. The current trend to attract and retain skilled construction labourers (SCLs) is to offer high salaries, which inflate construction costs. Generational differences, changing cultural and work values, and limited career advancement impact the longevity of a career in the trades. Moreover, SCLs' concerns about job security during economic downturns increase their departure from the construction industry in search of less volatile careers. Adversely, in the last few decades, Michigan has experienced more economic downturns than most other states. Economic uncertainty also affects the financing of construction projects in all market sectors, risking changes in scope and the feasibility of starting and

completing deliverables. The rising cost of residential construction is particularly concerning because it increases rent, widening socioeconomic inequality and increasing levels of homelessness (Horowitz et al. 2023). Without remediating the SCL shortage, these unfavourable circumstances will impede economic growth, urban development and social equity, impacting the future quality of life for many Michigan residents.

This study aimed to survey construction workers and project managers (PMs) to identify the perceived causes of the skilled labour shortage. This would provide a reflection from inside the industry and aid in identifying the priorities to address and reform, to recover from this shortage.

Limitations of this study include a 95% confidence interval and 10% sampling error, surveying 170 adult respondents mostly in Southeast Michigan. Opinions of high school students, parents, counsellors, human resource agents, and economists would offer insights yet were not sampled in this study. Multiple causes of the shortage reported in the literature may be remedied by addressing exposure, training, recruitment, retention, and advancement of careers in construction.

2 Literature review

As reported in scholarly articles and reports, the shortage of skilled trade labour is influenced by multiple factors, such as changes in population and demographics, education, economic cycles, cultural and work values, perceptions of a career, and reactions to catastrophic events (Simmons et al. 2018; Toppin 2018; Welfare et al. 2021; Bilginsoy et al. 2022; LePage and Tucker 2023; Ferguson 2024). Possible causes of the trade labourer shortage reported in the literature are low exposure rates, difficulties in recruiting, deficient skill levels, high turnover, and a lack of advancement in the career (Ayegba and Agbo 2015; Simmons et al. 2018; Welfare et al. 2021).

2.1 Population and demographics

Between 1950 and 2007, Americans' life expectancy at birth grew by almost 10 years (Crimmins et al. 2011) while retirement ages only slightly increased during that time (Tretina 2024). By 2034, retirees will outnumber children in the U.S. for the first time (Bahar and Casas-Alatrisme 2022). Michigan's average retirement age has consistently been 62 years, 1–2 years earlier than the national average (Tretina 2024). International migration into Michigan continues yet is disproportionate to its rank as the 10th

most populous state. More people are leaving the state than moving into it, and most domestic migrants are at retirement age. Due to domestic and international migration, retiring workers, and lower birth rates, Michigan's population is forecasted to decline by 2045 (Turner et al. 2023).

One demographic is predicted to increase in population by 2050 – people of colour will constitute 40% of Michigan residents (Turner et al. 2023), yet Black and Asian persons are acknowledged by government organisations as underrepresented in the construction industry. In 2022, the representation of Black persons was as follows: 7.1% skilled trade labourers, 5.8% managerial workers, and 6.8% combined skilled labourers and managerial occupations. Asian persons had even lower statistics with 1.6% skilled trade labourers, 3.5% managerial workers, and 2.1% combined skilled labourers. Also underrepresented in the construction industry, women accounted for 4.1% of skilled trade labourers, 16% of managerial workers, and 7.4% of combined skilled labourers and managerial occupations (US Bureau of Labor Statistics 2020).

2.2 Career and technical education (CTE)

Nationwide from 1990 to 2009, there was a reduction in high school students taking classes in construction and architecture in CTE programmes (US Department of Education 2013). However, between 2008 and 2015, Michigan experienced a 70% increase in apprenticeship programmes, the majority of them in the skilled trades (Wein 2016). Most of Michigan's apprentices hold high school diplomas, belong to a union, and were White males. By 2018, Michigan's apprenticeship programmes ranked first in the Midwest and third in the nation (Lewis 2019), and as of 2023, 39% of Michiganders did not agree that a college education is worth the cost (Eggart 2023). While perceptions of the importance of a college education are beginning to decline, reforming high schools and rebuilding vocational programmes will require policy changes, funding, and time (Associated General Contractors of America and Autodesk Construction Cloud 2023). Maag and Jacoby (2024) reported that currently only 62% of Americans have earned bachelor's degrees. A Progressive Policy Institute study found that federal funding for postsecondary education and training in 2022 spent 80% on academic programmes compared to only 20% on workforce education. Repairing future postsecondary educational funding discrepancies must involve policy changes with input from employers to avoid suffering further economic consequences (Maag and Jacoby 2024).

2.3 Economic cycles

The construction industry is seasonal, cyclical, and sensitive to economic changes, causing concern for retention of SCLs (Welfare et al. 2021). At the turn of the 21st century, Michigan's economy suffered due to budget cuts in response to a cyclical deficit (Michigan State University n.d.). At this time, Michigan endured what many refer to as a 'single state recession', with persistent declines in employment at a time when the national economy was growing. During the Great Recession, which began in December 2007 and lasted until June 2009, Michigan suffered more than other states due to its reliance on the automotive industry, resulting in the nation's highest unemployment rate and further hardship to Michigan's residents in the form of personal and community financial struggles. American workers left their industries to pursue higher education or less cyclical professions after the recession (Beyer 2017). Due to economic improvements in their home countries and stricter U.S. immigration laws, many international labourers also left and have not returned. U.S. home builders struggled to find trade labourers, especially electricians and bricklayers. This led to increased recruitment by offering higher labourer wages, which resulted in a 30% increase in the median price of homes.

2.4 Cultural and work values

Brown's (2002) value-based career theory hypothesised that genetics and one's life experiences influence one's values at work. These values are then further influenced by job satisfaction over periods of time. Simmons et al. (2018) studied work values of construction professionals across three generations: millennials, Generation Xers, and baby boomers. The results included a small but significant trend of less employer loyalty from millennials, the youngest generation group. It also found that all generations wanted their opinions to be heard and their skills advanced. Chan et al. (2020) reported that young potential tradespersons were reluctant to join any industry that interfered with their freedom and personal life. Perceptions of the long hours associated with a career in construction were a clear disincentive. This collective focus has continued after the COVID-19 pandemic, when people quit their jobs across many industries in search of a better work-life balance (Ferguson and Lucy 2024).

2.5 Perceptions

Business Leaders for Michigan (2023) stated that prospects for supporting a family with only a high school degree

are no longer as encouraging as they were last century. Current perceptions of a career in the trades differ from when Europeans settled in America, bringing master craftspersons with expertise that commanded respect (Public Sector Consultants Inc. 2017). Soral et al. (2022) reported that some careers crucial to supporting the necessities of a society involve commitment, getting dirty, working hard, and facing daily safety concerns. These professions do not require advanced education and are unfortunately associated with a stigma of lower hierarchical standing. The concern about how people perceive a career in construction is relevant regarding the recruitment of potential workers within a competitive future of labour shortages across all industries (Maurer 2023).

2.6 Catastrophic events

Climate change and pandemics are expected to affect the population of workers in Michigan (Turner et al. 2023). In 2022, Baral et al. (2022) warned that the COVID-19 pandemic would lead to further disparity in the ratio of men and women in the workforce, affecting interfamily relationships. They also expressed that this trend is a sea change from previous contributing factors of progress for women in the workforce, such as during World War II, when women freely replaced male workers and never returned to domesticity. Antithetically, the COVID-19 pandemic instigated a mass departure of women from the workforce to become caregivers (LePage and Tucker 2023; Ferguson 2024). In 2020, the population of Michigan's women of working age was only slightly lower than men (U.S. Census Bureau n.d.), yet they represented only one in 10 employees in Michigan's construction industry, consistent with previous years (Gallagher 2022). Conversely, with 7 million people moving from state to state each year, climate change may potentially attract domestic migrants to Michigan to escape coastal, volatile weather (Turner et al. 2023).

2.7 Low exposure rates

The lack of access to shop class in public schools resulted in less encouragement to enter a career in the skilled trades (Terpstra 2023). The change from industrial art programmes in junior high to high school meant that children were no longer introduced to skilled trades as pre-teens (Toppin 2018). Without exposure at an earlier age, children focus on academic studies instead of forming an interest in a hands-on occupation. Exposure and experience during teen years aid in vocational programme readiness and are advantageous to potential employers,

seeking labourers with skills. In 2018, most Michigan families with students were unaware of the opportunities and benefits of apprenticeships, and only 13% of high schoolers considered enrolling in one (Michigan Labor and Economic Opportunity 2018). By 2019, there were over 1,000 Michigan registered apprenticeship programmes offering benefits and remuneration to 21,000 registered apprentices (Lewis 2019). Bilginsoy et al. (2022) stressed that while apprenticing, students earn a good wage while also learning.

2.8 Difficulties in recruiting

In 2023, negative perceptions and the lack of knowledge of the viability of a career in the skilled trades contributed to employers' increasing recruitment efforts, resulting in 81% pay increases and 44% more incentives and benefits (Associated General Contractors of America and Autodesk Construction Cloud 2023). An additional deterrent to finding skilled workers was the reporting that only two of three potential employees could pass a drug test. Results from a 2022 diversity, equity, and inclusion (DEI) study commissioned by North America's Building Trades Unions (NABTU) and the Institute for Construction Employment Research (ICERES) included participants of laborious work (Bilginsoy et al. 2022). The study also reported that women's delays in beginning apprenticeship programmes may be due to caregiving and household responsibilities. Chan et al. (2020) also inferred that the long hours of the construction industry may conflict with raising a family.

Companies with variable diversity recruit and retain creative and committed employees (Mills et al. 2006, as cited in Simmons et al. 2018). While traditionally defined diversity (gender or ethnicity) is a contributing factor to successful companies, cognitively diverse teams are also faster at problem-solving than cognitively homogenous teams (Reynolds and Lewis 2017; Simmons et al. 2018). One reason for the low apprentice rates of women and people of colour could be that knowing someone who is an apprentice might influence decisions regarding who is admitted to programmes (Bilginsoy et al. 2022). Manesh et al. (2020) reported that studies of minorities in the construction industry are in their infancy.

2.9 Deficient skill levels

The construction industry values experience over degrees in education (McCord et al. 2023). In most European countries, apprentices begin their training in their

late teens (Bilginsoy et al. 2022). However, in the U.S., workers join apprenticeships at a much later average age of 26 for men and 31 for women (Bilginsoy et al. 2022) and in Michigan, 27 and 30, respectively (Wein 2016). Apprenticeship programmes are rigorous and require construction math skills (Bilginsoy et al. 2022). Because of redlining and deficits in revenue due to low local property tax, people of colour are more likely to have come from disadvantaged schools and may need additional training, such as pre-apprenticeship programmes, upon finishing high school (Nadworny and Turner 2019). Education in the city of Detroit was affected negatively after the Supreme Court ruling in 1976's *Milliken vs. Bradley*, which resulted in the reversal of planned educational policies to thwart desegregation by bussing Detroit students to nearby affluent suburban school districts.

In 2022, on average, 69.2% of Black apprentices quit programmes compared to a quit rate of 13.6% of White apprentices. While women and people of colour have less success completing apprenticeships (Bilginsoy et al. 2022), Belman (2022) reported that even partial participation in an apprenticeship programme increased lifetime earnings by almost \$100,000 per person over non-participants. A 2012 study by Mathematica found that individuals who completed a registered apprenticeship programme earned \$240,000 more over their working lives than similar non-participants (Public Sector Consultants Inc. 2017). According to the U.S. Bureau of Labor Statistics (BLS) (2022), nationally, female SCLs are paid 84% of a man's dollar, significantly higher than some other industries that do not require a college education.

2.10 High turnover

During economic downturns, owners may delay projects creating financial uncertainty for construction companies potentially causing employee departure for careers with better job security. Ayegba and Agbo (2015) reported tradespersons' dissatisfaction with pay and benefits, lack of advancement, and negative conduct of managers affected longevity in their careers. Additionally, a Construction Dive survey found that nearly 65% of respondents witnessed racism while working on a construction site with almost no managerial follow-up or accountability (Goodman 2020). In 2022, the ICERES DEI study found that the longevity of women's careers in construction depended on their ability to be resilient when facing sexual harassment and hostility from other workers (Bilginsoy et al. 2022).

2.11 Lack of advancement

Opportunities for advancement in a career in the trades are limited. Bilginsoy et al. (2022) reported that workers with many years of experience mentor new employees to lessen anxiety and are also encouraged to take on supervisory or administrative roles. However, minorities have fewer opportunities to become journey workers than White tradespersons. In contrast to the American Council for Construction Education (ACCE) reporting the possibility of quick advancement due to continuing education (Mansfield 2023), the highest level of career progression a skilled trade apprentice typically achieves throughout their work life is to become a general superintendent (Public Sector Consultants Inc. 2017). While further advancement is to become a business owner (Bilginsoy et al. 2022), starting one's own business requires a different set of skills and time to establish profit.

Reviewing the literature on Michigan's SCL shortage identified multifaceted opinions and findings of past researchers. The complex nature of the problem led the authors to approach this study with a broad perspective to capture intersecting data.

3 Research design and methods

3.1 Participants

The authors utilised their institution's Industry Advisory Board to compile a list of managers to contact for participants. Associations, such as the Construction Association of Michigan (CAM) and the Builders and Renovators Association of Greater Ann Arbor (BRAG), placed QR codes providing survey links in their newsletters. Construction companies found online were asked permission to survey SCLs and PMs.

Participants of this study are representative of Michigan's demographics of employed persons in the construction industry, as reported by the U.S. Census Bureau and BLS. The 170 participants were comprised of 69 PMs and 101 skilled labourers. Regarding race, 147 participants identified as 'Caucasian'; 8 as 'African American'; 7 as 'Latino/Hispanic'; 2 as 'Mixed race'; 1 each as 'Asian', 'Indigenous', and 'Pacific Islander'; and 3 chose not to answer. Concerning gender, 143 respondents identified as 'male', 18 as 'female', 7 as 'other', and 2 chose not to answer. Regarding age groups, 15 participants answered as '18–25', 58 as '26–39', 56 as '40–53', 37 as '54–62', and 4 as '63 and over'.

3.2 Procedure

This study began with a literature review to better understand a potential labourer shortage in Michigan, how the Great Lakes Region would influence a shortage, and how a shortage would compare to the United States, specifically in the construction industry. Scholarly articles reported the five key influencing factors of a shortage to be education, demographics, economic cycles, work environments, and perceptions. Common theories on the causes of the labourer shortage were found to be low exposure to the trades, deficiencies in skill sets, difficulties in recruiting labourers, a high turnover of workers, and a lack of advancement for employees.

3.3 Data collection

Analysis of scholarly articles, government reports, periodicals, and case studies identified causes, influential factors, and research gaps. These results generated 31 SCL and 33 PM structured survey questions. The surveys were created using Google Forms and accessed by URL links and QR codes. Anonymous participants were mostly located in Southeast Michigan with others around the state. Surveys were emailed to 180 contacts, reaching an unknown number of PMs. SCL surveys were collected with permission on construction sites.

3.4 Data analysis

A simple random sampling method was used for statistical accuracy with a 95% confidence interval and a 10% sampling error. This study used the analysis of variance (ANOVA) parametric statistical test when the data's characteristics met the requirements for normality and homogeneity. For ordinal variables, the researchers used the non-parametric Kruskal–Wallis statistical test instead. Suitable post-hoc tests (student *t* test for ANOVA, Mann–Whitney *U*, Dwass–Steel–Critchlow–Fligner pairwise comparison test, or Brunner–Munzel test for Kruskal–Wallis) were conducted to identify the two groups that had significance.

4 Results

The researchers surveyed SCLs and PMs to understand the causes and factors influencing the shortage of SCLs in Michigan. The survey questions were categorised as

follows: ‘Demographics’ to identify the distribution of the sample group and participants’ opinions and experiences across different categories; ‘Work Environment’ regarding trust, management style, mentoring, teaching, learning, job benefits, security, belonging to a union, pride in one’s work, stress from a job in construction, a work-life balance, and future work plans; ‘Education’ regarding exposure to trades, training, and education levels; ‘Perceptions’ regarding automation, technology, diversity, immigration, and the availability of trade schools; and ‘Employment’ regarding time spent recruiting and the types of construction work in which the study sample participated. Out of the 32 survey questions analysed, 6 yielded significant results. The following sections provide a summary of these findings.

4.1 Job longevity depending on age

The question about participants’ willingness to continue working in their trade was posed to both SCLs and PMs to understand if different age groups have varying expectations about how long they plan to work in the construction industry. Significant results were obtained via analysis using the Kruskal–Wallis test. While the respondents 40 years of age and older overwhelmingly (>90%) expected to work until retirement, respondents between 26 years and 39 years had differences of opinion between until ‘Something better comes along’ (17%) and ‘Retirement’ (76%), where the post-hoc Brunner–Munzel pairwise comparison identified a p -value of 0.022 (see Table 1).

4.2 Joblessness depending on union membership

To compare joblessness experiences between union and non-union participants, this study questioned union membership solely for SCLs. Both groups were asked about being jobless (out of work between construction jobs). The results showed significant differences through the Kruskal–Wallis test ($p < 0.001$), where 75% of union

respondents experienced joblessness, compared to 46% for non-union workers (Table 2). Given the unexpected nature of this finding and the small sample size between groups, this matter deserves further investigation in future studies.

4.3 Education level related to joblessness

This study investigated how different career training methods in the trades impacted job security for SCLs. Using the Kruskal–Wallis test, significant differences were found with ‘Jobless’ as the dependent variable and ‘Education Levels’ as the grouping variable. A post-hoc Dwass–Steel–Critchlow–Fligner pairwise test (p -value = 0.044) indicated that participants with 4-year degrees had a lower likelihood of joblessness contrasting with those without 4-year degrees who reported higher instances of joblessness. Sixty-five participants without a 4-year degree reported being jobless, while 26 did not. Dissimilarly, four participants with at least a bachelor’s degree reported experiencing joblessness; whereas, six participants did not. While the tests indicated significance, the small sample size is noted as a concern for further investigation.

4.4 Education level preceding union membership

This study then compared SCLs’ educational attainment with their union affiliation, allowing respondents to select multiple options. A Kruskal–Wallis test, followed by a post-hoc Dwass–Steel–Critchlow–Fligner pairwise comparison test revealed significance in categories of ‘Internship/Apprenticeship’ ($p < 0.001$) and ‘4-year University’ ($p = 0.03$). Conversely, no statistically significant differences were shown concerning choices such as ‘Hobby’, ‘Vocational programmes’, ‘2-year Community College’, or ‘On-the-Job Training’. Notably, most individuals affiliated with a union opted for either an ‘Internship/Apprenticeship’ (54%) or ‘On-the-Job Training’ (41%). Contrarily, among non-union members, a significant proportion pursued education at either a ‘2-year Community College’ or a ‘4-year University’, constituting 66% of respondents collectively.

Tab. 1: Respondents’ work-life expectations based on age

Age (years)	Something better comes along	Retirement	Other
18–25	3	8	4
26–39	10	44	4
40–53	4	51	1
54–62	1	34	1
>62	0	4	0

Tab. 2: Respondents’ joblessness based on union membership

SCLs	Union	Non-union
Experienced joblessness	57	11
Did not experience joblessness	19	13

SCLs, skilled construction labourers.

4.5 Education level influencing a construction career choice

The survey compared SCLs’ education with the source that influenced them to choose a construction career. Using the Kruskal–Wallis test revealed a significant relationship between ‘Vocational School Programme’ and ‘Exposure in High School’ ($p < 0.001$). In the ‘Exposure in High School’ category, participants who were not exposed in high school (77) and did not attend vocational schools (75) outnumbered those who were exposed (of 24 exposed, 17 did not attend and 7 did attend) (see Table 3). Exposure to vocational programmes in high school increased the likelihood of attending of a vocational programme from 2 out of 77 (2.6%) to 7 out of 24 (29.2%). This result aligns with the perception that a college education is perceived as the primary route to a successful career.

4.6 Recruitment impacting the trade school shortage

This study surveyed PMs on their perception of trade school shortages and their recruitment methods. The analysis revealed a significant difference between PMs’ recruitment from unions and their perception of a trade school shortage. As shown in Table 4, PMs who hired SCLs from unions were significantly more likely to perceive a trade school shortage (p -value = 0.020).

Tab. 3: Influences on respondents’ exposure to vocational programmes

Exposure through high school classes	Exposure through post-high school advisor	Respondents that attended a vocational programme	Respondents that did not attend a vocational programme
No	No	2	72
No	Yes	0	3
Yes	No	6	17
Yes	Yes	1	0

Tab. 4: PMs’ use of unions compared to their perception of trade school shortages

Hired from unions	Perceived trade school shortage	Count
Yes	Yes	29
Yes	No	9
No	Yes	13
No	No	14

PMs, project managers.

5 Discussion

5.1 Exposure

As the results have shown that exposing high school students to vocational programmes greatly increases their chances of joining such programmes, investing in this effort would be of benefit in addressing the labour shortage issue. Nationwide, associations are promoting initiatives to improve DEI in construction union apprenticeships, yet DEI operational efforts in both large and small private construction companies are not always policies. Implementing DEI in these cases depends on the commitment of owners and executive teams to organise and follow through or delegate processes (Bilginsoy et al. 2022). In Michigan’s construction industry, independent stakeholders are actively focussing on introducing skilled trades to youth and diverse groups offering hands-on experience through associations and non-profits. A few examples are architecture, construction, and engineering (ACE) mentor programmes, trades programmes for youths and adults, and private companies exposing primary and secondary school students to construction sites and techniques.

Regarding education levels influencing a construction career choice, this study’s findings support the argument that a person’s decision to attend a vocational school is influenced by their exposure to such programmes during their high school years. Congressional policies towards education can have long-term impacts on career choices and preparedness. This was the experience after the NCLB Act promoted college as the only path to success, diminishing student access to vocational schools and reducing early introduction to skilled trades (Terpstra 2023). Children’s exposure to trades could be increased through diverse channels, such as school programmes, summer camps, and interactive museums and playgrounds. The Fair Labour Standards Act forbids many tasks related to paid construction jobs for youth under the age of 18, limiting legal exposure to construction tasks during part-time employment. Children need a safe introduction to skilled trades and new teaching techniques using innovative technology, such as authentic learning utilising augmented reality (AR) may be the answer (McCord et al. 2023).

In 2007, NABTU introduced the Multi-Craft Core Curriculum (MC3) programme, a comprehensive pre-apprenticeship readiness initiative to reintroduce construction education into high schools. It prepares participants for entry into registered apprenticeship programmes in construction trades, covering essential skills

and knowledge needed across multiple trades and providing a solid foundation for construction careers. Training methods for construction careers are changing to include cutting-edge technology, such as AR, autonomous construction equipment, and drones, which may attract younger individuals who were previously uninterested in pursuing careers in construction. As reported by NABTU, apprentices are currently honing their skills in handling complex software systems alongside traditional tools (North America Building Trades Unions [NABTU] n.d.).

5.2 Training

Union membership has decreased significantly over the decades, and current labour laws prevent union representation despite increased worker desire elevating competition for union apprenticeships (McNicholas et al. 2021). This study concluded that most union members are trained through internship/apprenticeship and on the job training while many non-union SCLs received their educations through 2-year and 4-year colleges. Chen (2024) reported that Generation Z (those born from 1997 to 2012) are embracing the trades, especially construction. This generational change is happening at a time when Michigan's college enrolment is one of the lowest in the nation (Lohman and Wilkinson 2023). To improve upon enrolment, 'Michigan Reconnect' allows 1-year residents, aged 21 and older without bachelor's degrees, to attend community college tuition-free (Michigan.gov n.d.). Michigan's 'Going PRO' offers training grants to bolster the skilled trades workforce (Terpstra 2023). Additionally, the Michigan State Housing Development Authority's 'Contractor Assistance Program' (Vicari and Bach 2023) and the City of Detroit's internal efforts aim to support contractors by leveraging funding and providing resources for training and project collaboration. Efforts by the bipartisan Growing Michigan Together Council prioritise increasing the state's population with strategies including marketing progressive policies, enhancing infrastructure, and securing sustainable funding (Executive Office of the Governor 2023). These circumstances combined with Michigan's numerous apprenticeship programmes offer an opportunity to rebrand Michigan as a destination for education and training in skilled trades, advancing Michigan's goals to increase its population and workforce.

The debate over the necessity of a 4-year degree for career success intersects with job security, influencing job satisfaction and retention. In 2022, Gallagher reported that construction workers are less likely to hold a bachelor's degree than those employed in other industries

(17.9% vs. 44.1%). In this study, individuals with a 4-year university education reported lower joblessness, contrasting with those without such qualifications; however, the significance of this study's finding could be correlated with another factor, such as belonging to a union. In 2015, Carlson and McChesney (2015) found that a higher level of education led to better job security even during economic downturns yet very little wealth growth compared to those with postgraduate education levels. This could indicate that taking on tuition debt for a bachelor's degree might not increase one's standard of living as much as gaining skills through vocational or apprenticeship training, incurring far fewer costs and even working while learning. The construction industry offers an opportunity to earn a good wage without incurring significant tuition debt.

Trade apprenticeship programmes can last up to 5 years. Initiatives, such as the 'Apprenticeship IS College' campaign (Brown 2023) and NABTU's 'earn-while-you-learn' motto (North America Building Trades Unions n.d.), highlight the benefits of pursuing a career in construction. Perceptions of being well-educated and literate need to change to include knowledgeable, skilled, problem-solvers. SCLs may not be viewed as scholars but could potentially be perceived outside the construction industry as highly skilled masters.

5.3 Recruitment

In this study, 65% of PMs responded yes to a perceived shortage of trade schools, while 35% did not. Notably, the preference for recruiting from 'Internships/Apprenticeships' over 'Trade schools' and 'Unions' suggests a growing emphasis on hands-on experience in the construction industry, as was observed in previous reports (McCord et al. 2023). The potential decline in recruitment from trade schools raises questions about their future relevance, indicating a shift towards practical learning. This shift may be further accelerated by emerging technologies, such as extended reality (ER) (Ellis 2024), offering benefits, such as improved visualisation and training for hazardous situations. This study found no significance in respondents' opinions regarding embracing technology or automation being good for the construction industry.

'Michigan Works!' is the first association in the nation offering a state sponsored collaboration between entry-level workers and employers seeking workforce development ("Michiganworks! Association" 2023). Only the private sector considers veterans and formerly incarcerated persons as underrepresented, and therefore, fewer statistics regarding their participation are available

(Gallagher 2022). Programmes, such as Helmets to Hardhats, provide veterans with pathways to trade careers, acknowledging their valuable skills and experiences (Bilginsoy et al. 2022). Michigan industries' commitment to workforce development is evidenced by their willingness to become 'second chance employers' to individuals with criminal records (Li 2023). Efforts to provide vocational training within correctional facilities, such as Michigan's Vocational Village programmes, demonstrate a proactive approach to preparing incarcerated individuals for re-entry into the workforce including focussing on many construction-related skills (Michigan Department of Corrections n.d.).

The McKinsey study found that gender-diverse teams outperform male-only teams, such as in compromising (34%) and mentoring (25%) (University North Carolina Pembroke 2021). Recruiting SCLs from underrepresented populations is promising, as ethnically and gender diverse teams are respectively, 36% and 25%, more fiscally beneficial to companies. This study's results showed no significant differences in participants' job satisfaction, stress management, and enjoyment of manual work when considering gender and race, highlighting an opportunity for a fair and inclusive work environment. Initiatives, such as maternity leave, addressing household and caregiving responsibilities, on-site childcare, and flexible schedules, can attract and retain women. Better benefits, pay, and union support would support all underrepresented persons in the construction industry (Bilginsoy et al. 2022). DEI is also improved through community persuasion and assistance with training expenses.

5.4 Retention

Concerns about job security during economic downturns significantly impact job satisfaction, emphasising the importance of addressing such anxieties (Artz and Kaya 2014). Retaining SCLs is paramount to stabilising construction costs. McNicholas et al. (2021) found that during the COVID-19 pandemic, union members reported better job security than non-union members. In contrast, this study revealed unexpected significance in the frequency of participants stating being out of work between construction jobs while belonging to a union. Concerns include the departure of highly skilled union members for better job security and more consistent wages. Loss of union SCLs results in higher expenses for employers due to costs associated with overtime, recruiting, and training new workers, ultimately increasing project durations and expenses. Further research is needed to confirm the results in Michigan and compare them to other locales.

Simmons et al. (2018) and Welfare et al. (2021) found small but significant findings of younger workers not investing in their work in the same manner as older, more experienced workers. This study's analysis maintains a small but continuing trend of generational differences concerning SCLs and PMS' plans to work in construction until retirement. Simmons et al. (2018) proposed a solution to retain younger workers by advocating for a company culture that embraces diverse values. Chan et al.'s (2020) research highlighted the significance of considering workers' perspectives on work-life balance. One important approach in Michigan is to improve retention in all industries by prioritising mental health considerations and reducing stress to increase safety (Michigan Labor and Economic Opportunity n.d.).

5.5 Experience and education

There were no significant differences found in participants' satisfaction levels with mentoring, training, and learning from peers, indicating a general openness among Michigan's construction workforce to teaching and learning from coworkers. Experienced SCL teaching in vocational schools could extend participation in the industry and avoid loss of practical knowledge, while reducing physical work and increasing mental stimulation. Emphasising the importance of a continued contribution to the industry for future generations could reshape retirees' perspectives on the timing of retirement and challenge prevailing retirement age norms by framing semiretirement as a ratio to life expectancy. Participation could supplement income and provide fulfilment by helping grow Michigan's economy, thus improving standards of living.

6 Conclusions

This study's contribution to the body of knowledge is to better understand the complexities of a current and projected construction trade labour shortage by collecting intersecting data based on the opinions of industry insiders (SCLs and PMS) located in the regional locale of Michigan. Quantitative data illustrative of the multiple factors influencing the SCL shortage was collected from a sample population demographically representative of construction statistics. Two independent surveys were given to SCLs and PMS, broadly covering categories, such as population and demographics, education, economic cycles, cultural and work values, and perceptions of a career in the trades. Work environment factors were analysed with questions regarding trust,

management style, mentoring, teaching, learning, job benefits, and security, belonging to a union, pride in one's work, stress from a job in construction, a work-life balance, and future work plans. Questions about education factors included the means of exposure to the trades, training, and levels of education. Perceptions were addressed through questions regarding automation, technology, diversity, immigration, and the availability of trade schools. The employment category targeted questions regarding time spent recruiting and the types of construction work in which the study sample participated. Demographics were analysed as a common theme within the scope of this study to identify the distribution of the sample group and participants' opinions and experiences across different categories.

Analysis of responses with ANOVA and post-hoc tests resulted in 6 significant findings, covering intersecting subjects of education, union membership, job security, and career perceptions. Enrolment in vocational school was predicated on exposure in high school. Respondents believed that recruiting through a labour union increases trade school shortages. Most union SCLs procured training through internships/apprenticeships and on-the-job. Seventy-five percent of union trade labourers experienced joblessness, compared to 46% of non-union workers. Participants without 4-year degrees had a higher likelihood of joblessness than those holding at least a bachelor's degree. Construction workers aged 26–39 had mixed expectations of remaining in the industry until retirement compared to those over 40 years old.

Lack of exposure to educational opportunities, changes in population, and negative perceptions of a career inhibit the recruitment of SCLs. Changes in the economy and values influence workforce retention due to concerns about job security and work-life balance. Trends in population and the economy might be predictable, but like people's values and perceptions, they are difficult to control. At times, these variables result in negative consequences without remedy. Alternatively, changes in education can be both predictable and planned. Therefore, adaptations in national or regional education opportunities must be considered to improve upon the SCL shortage.

Research involving high school students, parents, counsellors, and young adults will aid in understanding career decision-making processes and generational career choices in construction, including perceptions and exposure to trade schools, apprenticeships, and vocational education. Addressing the gap between high school graduation and apprenticeship enrolment can promote earlier entry. Surveying those who did not consider or complete

trade apprenticeships can reveal why Black persons, Asian persons, and women are underrepresented in construction. Examining SCLs' departure for better job security, alongside economic shifts and unemployment, is also valuable.

Further research is needed on the influence of union affiliation and apprenticeship participation on joblessness across regions. Studies should consider layoff experiences, benefits retention, and access to unemployment benefits. Collecting data from tradespersons aged 55 and younger can enhance understanding of SCLs' retirement plans, needs, and career aspirations, improving job satisfaction and retention. Analysing career advancement can assess the effectiveness of semi-retirement options, mentoring, and supplementary training programmes. Moreover, this study can be replicated in other regions to identify particular needs and priorities for attracting SCL. Future studies can be enhanced with questions on digital training tools and work-life balance.

Rebranding trade careers, adapting to changing employee values, and continuing DEI efforts are essential. Multifaceted surveys across states can identify regional causes of the SCL shortage, enabling targeted interventions through public education policies and coordinated efforts to address the shortage.

Data availability

Some or all data or code that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations of interest

The researchers declare that there are no conflicts of interest regarding this study.

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