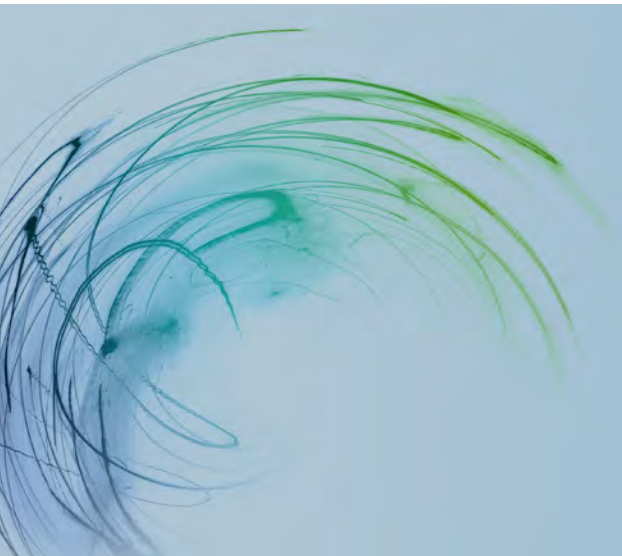
Final Report 335

Improving the U.S. Workforce Development System



ANNUAL CONFERENCE EDITION

CII ANNUAL CONFERENCE 2018

CII Member Companies

Owner Organizations

Abbott
Adventist Health
Ameren Corporation
American Transmission Company LLC
Anadarko Petroleum Corporation
Andeavor
Anheuser-Busch InBev
Aramco Services Company
Architect of the Capitol
Ascend Performance Materials
AstraZeneca
BP America, Inc.
Bruce Power
Cargill, Inc.
Chevron
ConocoPhillips
Consolidated Edison Company of New York
Consumers Energy Company
Covestro LLC
DTE Energy
Eastman Chemical Company
Eli Lilly and Company
EnLink Midstream
ExxonMobil Corporation
General Electric Company
General Motors Company
GlaxoSmithKline
Global Infrastructure Partners
Honeywell International Inc.
Huntsman Corporation
Irving Oil Limited
Johnson & Johnson
Kaiser Permanente
Koch Industries, Inc.
LyondellBasell
Marathon Petroleum Corporation
National Aeronautics & Space Administration
NOVA Chemicals Corporation
Nutrien
Occidental Petroleum Corporation
ONEOK, Inc.
Ontario Power Generation
Petroleo Brasileiro S/A - Petrobras
Petronas
Phillips 66
Pioneer Natural Resources
Public Service Electric & Gas Company
Reliance Industries Limited (RIL)
SABIC - Saudi Basic Industries Corporation
Shell Global Solutions US Inc.
Smithsonian Institution
Southern Company
Tennessee Valley Authority
The Dow Chemical Company
The Procter & Gamble Company
TransCanada Corporation
U.S. Army Corps of Engineers
U.S. Department of Commerce/NIST/EL
U.S. Department of Defense/Tricare Management Activity
U.S. Department of Energy
U.S. Department of State
U.S. Department of Veterans Affairs
U.S. General Services Administration

Breakthrough Organizations

Blue Cats
Concord Project Technologies Inc.
Construct-X, LLC
Design + Construction Strategies
Group ASI
iConstruct
Insight-AWP Inc.
O3 Solutions
OnTrack Engineering LTD

Service Providers

AECOM
APTIM
Atlas RFID Solutions
Autodesk, Inc.
AVEVA Solutions Ltd.
AZCO INC.
Baker Concrete Construction Inc.
Barton Malow Company
Bechtel Group, Inc.
Bentley Systems Inc.
Black & Veatch
Burns & McDonnell
CCC Group
CDI Corporation
Consolidated Contractors Company
Construtora Norberto Odebrecht S.A.
Continuum Advisory Group
CRB
CSA Central, Inc.
Dassault Systèmes SE
Day & Zimmermann
Deloitte
Eichleay, Inc.
Emerson
Enstoa, Inc.
ePM
Fluor Corporation
FMI Corporation
Hargrove Engineers + Constructors
Haskell
Hatch
Hexagon Process Power & Marine
Hilti Corporation
Hitachi Construction Machinery Co., Ltd.
I.M.P.A.C.T.
IHI E&C International Corporation
Jacobs
JMJ Associates LLC
KBR
Kiewit Corporation
Linde North America
M&H Enterprises (Energy Services)
Matrix Service Company
McCarthy Building Companies, Inc.
McDermott International, Inc.
McKinsey & Company, Inc.
Midwest Steel, Inc.
NPCC
Pathfinder, LLC
PCL Constructors, Inc.
Pillsbury Winthrop Shaw Pittman LLP
PTAG, Inc.
Quality Execution, Inc.
Richard Industrial Group
S & B Engineers and Constructors, Ltd.
Saipem SpA
Samsung Engineering America
Saulsbury Industries
SBM Offshore
Siemens Energy, Inc.
Sinopec Engineering (Group) Co., Ltd. - SEG
Skanska USA
SNC-Lavalin Constructors Inc.
TechnipFMC plc.
The Beck Group
thyssenkrupp Industrial Solutions (USA), Inc.
Turner Industries Group LLC
Valency Inc.
Victaulic
Wanzek Construction, Inc.
Wilhelm Construction, Inc.
Wison Engineering Ltd.
Wood
WorleyParsons
Zachry Group
Zurich

Improving the U.S. Workforce Development System

Prepared by

Construction Industry Institute
Research Team 335, Improving the Workforce Development System

With assistance from

The National Center for Construction Education and Research (NCCER)

Construction Users Roundtable (CURT)

Ironworker Management Progressive Action Cooperative Trust (IMPACT)

Final Report 335
CII Annual Conference 2018 Edition

July 2018

Printed in the United States of America.

Executive Summary

The construction industry has repeatedly faced the problem of craft professional availability over the past 30 years. During periods of economic expansion, wages for craft professionals typically increase and the average quality of the workforce decreases as less qualified craft professionals enter the industry to take advantage of wage opportunities. During periods of economic contraction, craft professionals are forced to leave the industry and the process repeats itself during the next economic cycle. This phenomenon is well understood by experienced construction personnel; however, experiences by construction stakeholders since the 2008 Great Recession indicate that fundamental structural changes have occurred to the construction workforce development system and society as a whole that pose significant risk to the construction industry. The issue of having a qualified workforce can no longer be considered a union or open-shop issue, but rather a challenge for the entire industry.

CII Research Team 318 identified that a number of significant issues face the North American construction industry today:

- The average age of craft professionals within the industry is increasing and the rate of this increase is four times the national average for all other industries. Most of this is due to young craft professionals not entering the industry.
- The wage gap between construction craft professionals and all other industries has steadily decreased over the past 30 years, at a time when the highest job motivation for craft professionals evolved from a pride in work accomplished to simply a high wage rate.
- While there have been pockets of success in some U.S. geographic locations, Hispanic craft professionals have not penetrated the more industrial-focused trades (e.g., welder, pipefitter, and electrician) due to low educational attainment at the high school level.
- Finally, over the past 30 years, the U.S. education system has been purposely designed to push young people away from vocational training and into four-year colleges and universities.

The result of these, and other factors, is that the construction industry is shifting from the long-experienced problem of not having enough qualified craft professionals to the problem of not having enough craft professionals, period. The result is a statically significant, direct linkage between craft professional availability and construction project safety, cost, and schedule performance. What is most alarming about these trends is that they are largely independent of the traditional economic drivers of construction (e.g., oil prices, GDP); they are indicators of fundamental underlying changes in the U.S. workforce development system.

The lack of an effective workforce development system represents a threat to the economic prosperity of not just the construction industry but the United States as a whole. Workforce development can be described as a four-part process consisting of **recruitment** to the industry, **training** for those in the industry, **retaining** the human resource capital that the industry develops, and **placing** the craft professional in opportunities for the person to excel throughout their career. In addition, the construction workforce development system involves many organizations across different sectors, outside of construction, and in multiple locations. It is a complex system requires advanced modeling techniques to fully understand the intricacies and factors influencing its performance.

This research answered two essential questions:

1. What can be done to make the U.S. construction workforce development system effective?
2. Which changes will position the U.S. construction workforce development system as a world leader

For the purposes of this research, the workforce development system includes elements of the U.S primary, secondary, and post-secondary education system, construction training, and placement and retention efforts of craft professionals. Elements that were excluded from the scope of the work include unemployment problems (e.g., underemployment), specific primary, secondary, and post-secondary curriculum design, and comprehensive immigration reform.

How did we proposed redesigning the U.S. workforce development system? The required effort goes beyond any single implementation resource, any construction firm, and CII. The effort will require new approaches in how we communicate career opportunities to youth in secondary and post-secondary education, and work-based training among other initiatives. The efforts described in the technical report formulate a series of policy recommendation that have been developed that impact industry stakeholders and governmental agencies. Considering the relative benefits and costs with each policy, there are policies we can be implementing in the short term (less than three years), and these policies will require long-term sustained efforts.

Short-term Workforce Development Policies

Establish and strengthen the awareness of career opportunities in our nation. Most graduating high-schoolers expect to earn a bachelor's degree to enhance employment opportunities and make more money, yet most jobs in the U.S. require a career and technical education (CTE) and associated certification. We must establish our nation's commitment to the equality of all workers by recognizing the dignity of their contribution to society.

Revitalize our work-based learning programs. Despite the tremendous benefits associated with work-based learning, it remains a marginal education strategy in the U.S. Our nation needs to significantly improve participation in work-based learning programs by removing barriers to company participation and promoting its exposure in secondary education.

Measure performance and involvement in workforce development when awarding construction contracts. When owners recognized the importance of safety, they held their contractors to high standards of safety performance, which helped with long-term improvements in worker health and safety. Owners need to assess construction firms' dedication and commitment to workforce development much like they consider their devotion to safety.

Longer-term Workforce Development Policies

Redefine how we measure the quality of our nation's secondary education system by career and college readiness. In terms of preparing graduates of our nation's secondary education system, "career readiness" and "college readiness" are currently used interchangeably. Although academic proficiency is essential for any post-high school achievement, career readiness is a broader concept than just preparing individuals for university studies. At a minimum, all high school graduates should be career ready. The nation's secondary education system should be provided greater incentive to ensure the career readiness of all high school graduates.

Increase the participation of groups underrepresented in CTE. The groups that represent the greatest opportunity for new workers in the construction industry include women, minorities, and veterans. To increase the numbers of these groups within the construction industry, we must increase their presence within secondary and post-secondary CTE programs. This policy helps in recruiting these individuals into construction, but the industry must do a better job of retaining these future professionals with improved worksite conditions and other incentives.

Establish and expand collaboration between industry, education, and government. Industry and business leaders directly feel the challenge of recruiting people for non-managerial roles who possess the required skills, training, and education. To promote CTE in both secondary and post-secondary education levels, the industry has to take an active role promoting industry involvement and investment into our nation's secondary and post-secondary CTE programs.

Develop a more balanced funding of post-secondary alternatives: career and technical education as well as university systems. A sizable portion of public education and workforce funding is not effectively allocated to meet the needs of the national economy. The overall governmental funding received by CTE programs across the U.S. has declined over the last decade. As a nation, we must increase funding available to the CTE programs most needed by industry, through direct funding, incentive programs, and streamlined governmental funding programs.

Contents

Chapter 1
Introduction

> *"I believe in the dignity of labor, whether with head or hand; that the world owes no man a living but that it owes every man an opportunity to make a living."*
>
> *– John D. Rockefeller, 1941*

1.1. The Lost Dignity of American Labor

The United States' workforce development system is in desperate need of expansion and renewal. As a system, workforce development includes the recruitment, training, placement and retention of individuals in gainful employment opportunities. While the U.S. workforce development system has been supportive for many occupations, especially occupations requiring university degrees in science, technology, engineering, and math, it has unfortunately not kept pace with meeting the needs of the majority of occupations in the U.S. that typically require a degree or certification in career and technical education (CTE).

While the U.S. was built on the premise of an equality of labor – that all occupations are necessary and respectable in society – it has transformed to the point where many of its citizens believe that certain jobs and skills are more valuable and necessary for their success as a nation and as communities. Under the "New Economy," occupations across many industries have suffered a loss of dignity and respect. Despite having built one of the world's greatest infrastructure system – from the interstate highway system to the Hoover Dam and the Alaskan Pipeline – the construction industry has seen its reputation as an employer decline to the point where its occupations typically rank near the bottom of all U.S. occupations when survey respondents are asked to consider its jobs' physical demands, stress, income, and outlook. A problem with these job rankings is that they often group together multiple distinct occupations, often because the survey-givers do not realize the complexity of the construction industry and the variability in supply and demand that exists across the construction trades and the different sectors of construction.

The poor reputation of working in the construction industry goes beyond metrics. One unfortunate perception is that many workers end up in the construction industry after exhausting job opportunities in other industries. An underlying belief that construction occupations make limited mental demands supports this perception. Despite this poor reputation, studies have shown statistical evidence that construction workers have greater levels of job satisfaction than their counterparts who work in other industries.

Due to these deficiencies, a shortage of construction workers has emerged that threatens our nation's ability to renew its infrastructure when it needs it most. The shortage is real, and it is already affecting the performance of construction. Currently, the construction industry faces workforce shortages among highly skilled occupations, including electricians, pipefitters, welders, boilermakers, millwrights, and ironworkers, mainly due to high demand (Wilder 2013; Shelar 2013; Gonzales 2013). All of these occupations relate to industrial projects, and Karimi et al. (2016) found that the shortages are already having a significant impact on project performance in the industrial construction sector.

1.2. How Did We Get Here?

The craft workforce shortage was predicted and grew over decades. In 1983, The Business Roundtable (BRT) predicted that a shortage of skilled craft workers would hamper the growth of both open shop and union construction sectors by the end of that decade (BRT 1983). The prediction was confirmed by a 1996 BRT study that found that 60% of its surveyed members were experiencing a shortage of skilled craft workers; 75% of the respondents indicated that the shortage had worsened in the five years prior to the study (BRT 1997). The shortage of craft workers worsened further in the 2000s. In 2001, the Construction Users Roundtable (CURT) conducted a survey in which 82% of the respondents reported shortages on their projects; 78% of the same respondents indicated that the shortage had worsened in the three years prior to the study (CURT 2001). In 2007, that number had risen to 86% (Sawyer and Rubin 2007).

During the most recent economic downturn that began in 2008, the U.S. construction industry experienced immediate increases in unemployment as a result of the decrease in demand for construction projects. Yet the economic downturn also preceded what is now considered the longest economic recovery period in the construction industry, as well as in all other U.S. industries (Fridley 2013). In addition, the Bureau of Labor Statistics (BLS) estimates that the U.S. construction industry will be the fastest-growing industry over the next decade, creating an estimated 1.6 million jobs (Glavin 2013; Gonzales 2013). However, in periods of high regional construction volume, hiring and retaining skilled craft workers is challenging, because companies must compete for a relatively fixed craft labor pool that shrank during the preceding recessions as unemployed craft workers sought jobs in other industries (FMI 2013). Given this high demand, companies are losing money due to the lack of skilled craft workers for construction. According to the Associated General Contractor (AGC), 79% of construction companies in the U.S. are having difficulties finding qualified workers to fill job openings (AGC 2015), especially in the Gulf Coast region (Wilder 2013). Multiple recent studies have triangulated on the significance of the craft workforce shortages (see Table 1).

Table 1. Construction Craft Shortages, Nationally and Regionally, from Previous Studies

#	Reference	Sector	Method Used	National Crafts shortages (All)	National Craft Shortages (Top Five Crafts)	Study Regions Number	Regional Shortages (Ranked in Four Regions by Participant Percentage)	Hardest Trades to Fill (by Four Regions)
1	Associated General Contractors of America (2016)	Mainly Commercial	Survey	69%	carpenters, electricians, roofers, plumbers, and concrete workers	4	**1st**: Midwest (77%) **2nd**: South (74%) **3rd**: West (71%) **4th**: Northeast (57%)	**Midwest**: carpenters. **South**: cement masons. **West**: bricklayers. **Northeast**: plumbers.
2	CII RT-318 (2015)	Mainly Industrial	CLMA©	N/A	N/A	9	**1st**: Southwest, Southeast, Mid-Atlantic (classified as subregions of **South**) **2nd**: Midwest **3rd**: Rocky Mountains (classified as subregion of **West**)	**South** *(represented by subregions)* *Southwest*: electricians, pipefitters, and welders. *Southeast*: electricians, pipefitters, and welders. *Mid-Atlantic*: electricians, pipefitters, and welders. **Midwest**: electricians, and welders. **All other regions**: welders.
3	Associated General Contractors of America (2015)	Mainly Commercial	Survey	79%	carpenters, sheet metal installers, concrete workers, electricians, and equipment operators	4	**1st**: Midwest (85%) **2nd**: South (83%) **3rd**: West (81%) **4th**: Northeast (73%)	**Midwest**: carpenters. **South**: carpenters. **West**: millwrights and painters. **Northeast**: carpenters.
4	Associated General Contractors of America (2014)	Mainly Commercial	Survey	83%	carpenters, roofers, equipment operators, plumbers, and electricians	4	**1st**: South (86%) **2nd**: Midwest (84%) **3rd**: West (82%) **4th**: Northeast (67%)	**South**: roofers. **Midwest**: carpenters. **West**: plumbers. **Northeast**: electricians.
5	Associated General Contractors of America (2013)	Mainly Commercial	Survey	74%	laborers, carpenters, cement mason, pipefitters/ welders, and equipment operators	N/A	N/A	N/A
6	U.S. Green Building Council (2013) McGraw-Hill data	Non-Industrial	Survey	49%	carpenters, electricians, boilermakers, concrete finisher/cement mason and ironworkers/ welders	N/A	N/A	N/A
7	Wilder (2013)	Industrial	Survey	N/A	N/A	1	Gulf Coast[1]	welders, pipefitters, ironworkers

© Construction Labor Market Analyzer

At the national level, the similarities among occupations observing to have significant shortages include “electricians” (AGC 2016; AGC 2015; AGC 2014; USGBC 2013), “plumbers” (AGC 2016; AGC 2014), “pipefitters” (AGC 2013), “laborers” (AGC 2013), and “concrete finishers/cement mason” (AGC 2013; USGBC 2013). In the Northeastern region, AGC (2015) found that “carpenters” were hardest to find while AGC (2016) found that “plumbers” were hardest to find; this study’s findings show a shortage for both of these occupations, in addition to the “construction laborers and helpers” occupation. In the Midwestern region, CII (2015), using CLMA[1] data, found that “electricians” and “welders” were hardest to find; this study’s findings show a shortage among “electricians” in addition to the “pipe-layers, plumbers, pipefitters, and steamfitters” occupation. In the Southern region, CII (2015) found that “electricians,” “pipefitters” and “welders” were hardest to find, while Wilder (2013) found that “pipefitters,” “welders,” and “ironworkers” were hardest to find; this study’s findings show a shortage on the “electricians” and “pipefitters” occupations, in addition to the occupations “construction equipment operators” and “construction laborers and helpers.” In the Western region, AGC (2014) found that “plumbers” were hardest to find; this study’s findings show a shortage in that occupation, in addition to the “electricians,” “carpenters,” and “construction laborers and helpers” occupations.

Despite the differences behind the methods of the data collections, analyses, and results among these different research efforts (see Table 1), the similarities in the findings validates that a shortage of construction craft workers exists. If we as a nation and an industry do nothing, the shortage will get worse. Looking into the future, a study by Vereen (2013) forecasted the craft demand for skilled construction labor in the U.S. considering multiple factors (labor demand, interest rate, material prices, construction output, productivity, and real wages). Vereen (2013) used monthly data between 1990 and 2011 from multiple datasets, she applied a Vector Auto Regression (VAR) model for forecasting labor demand in construction and found that a range between 5.3 and 6.3 million skilled construction workers will be in demand by 2022, which means the current skilled workforce needs to increase by 1.3 to 3 million workers by 2022. If we began addressing this increased demand now, the industry needs to recruit, train, and retain 145,000 to 330,000 new workers each year to meet the forecasted demand. The longer we wait to improve our industry the greater the challenge will become.

1 The Construction Labor Market Analyzer (CLMA) is “an online application that helps owners, contractors, labor providers and the construction industry overall understand the skilled labor market and manage project labor risk” (CLMA 2015). All of the industrial projects in the CLMA are actual projects whether provided directly by the owner or input and managed by the CLMA analysts. For Non-Industrial Information CLMA analysts obtain the entire McGraw Hill Dodge (Dodge Analytics) portfolio. CLMA analysts transfer these future projects into estimated number of workers in a particular trade and in a specific region. However, the Bureau of Labor Statistics (BLS) provides estimates of the number of people in a particular trade and in a specific region (the number includes industrial and non-industrial workers). The authors of the CII RT-318 used the BLS number as an estimated supply and CLMA number as an estimated demand.

1.3. Purpose, Objectives, and Scope

This research addressed two essential questions:

1. What can be done to make the U.S. construction workforce development system effective?
2. Which changes will position the U.S. construction workforce development system as a world leader?

To answer these questions, RT-335 achieved the following objectives:

1. Document and formally model the current U.S. workforce development system(s).
2. Analyze the current U.S. workforce development system for deficiencies, strengths and how construction industry stakeholders and workforce participants influence workforce development outcomes.
3. Design an effective workforce development system that will serve the needs of the construction industry and identify measures that can be used to evaluate the performance of the system.

For the purposes of this research, the workforce development system includes elements of the U.S primary, secondary, and post-secondary education system, construction training, and placement and retention efforts of craft professionals. Elements excluded from the scope of the work include unemployment problems (e.g., underemployment), specific primary, secondary, and post-secondary curriculum design (but outcomes may be identified), and comprehensive immigration reform.

In the following chapters, RT-335 describes the reasons why the current workforce development system needed to be changed; outlines its overall research methods, which included survey research, numerous site visits throughout North America and Europe, and the Analytical Hierarchy Methods; offers its findings; and presents the final policy recommendations that its members feel will make the U.S. construction workforce development system a world leader.

Chapter 2

The Urgent Need for Change

Significant, ongoing efforts seek to improve the U.S. construction workforce development system, but these improvements need to occur on a significantly broader scale. In this highly fragmented industry that employs over five million workers across its production trades, a dramatic sea change is necessary for long-term improvement to occur. The urgently needed change will not only improve the performance of construction firms and individual projects: it will also improve the quality of U.S. society, as well.

2.1. National Unity through Infrastructure Renewal

More than ever, political issues divide the United States. If there is one issue that political parties can agree on, it is the need to renew the nation's infrastructure system. We are the nation whose transportation system was once the envy of most other countries, from the transcontinental railroad to the interstate highway system. Somewhere along the way, we became distracted and allowed the quality of our nation's transportation system to slip; the quality of our roads is now rated 16th in the world. Furthermore, the nation's transportation system is indicative of the current state of the nation's infrastructure system, including its public water, sewer, and civil works. Based on the latest evaluation of the nation's infrastructure system by the American Society of Civil Engineering, every state involved in the evaluation had its infrastructure systems rated as a C+ or lower. (See Figure 1.)

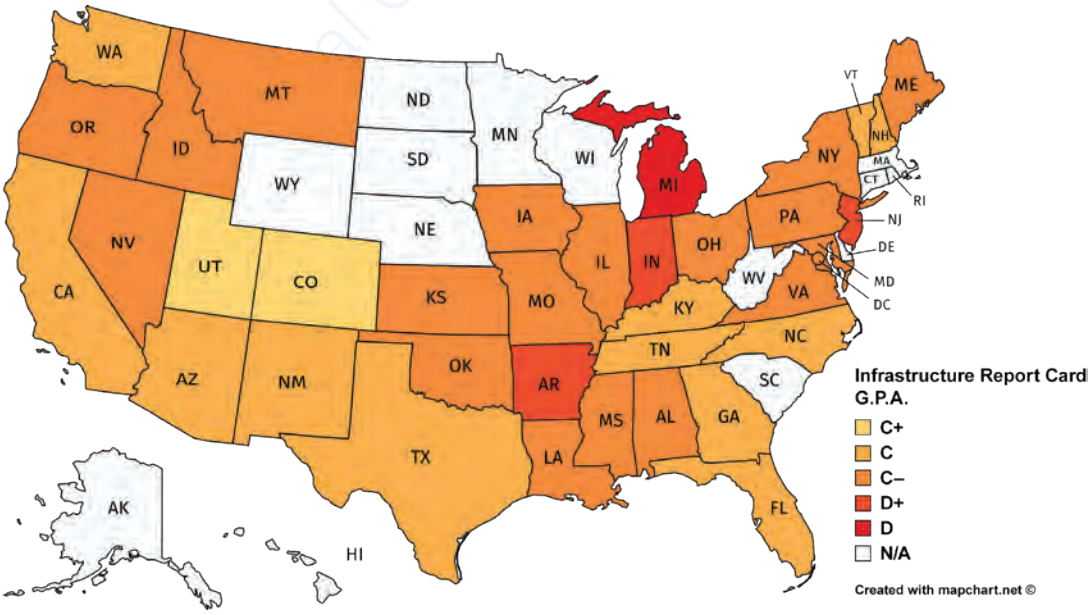
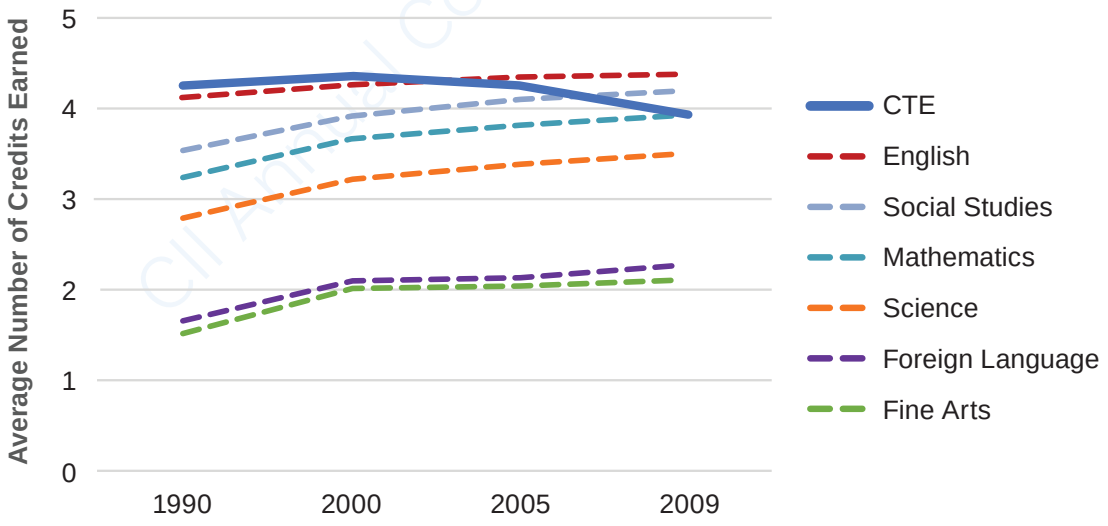


Figure 1. State of the Nation's Infrastructure System (ASCE 2017)

The erosion of our nation's infrastructure didn't occur during just one year or during a single Presidential administration. It has been eroding for decades. Reversing this decline however requires not just new investment and innovations in infrastructure but a new workforce. ***Even with dramatic increases in infrastructure funding and development of innovations, we as a nation no longer have the workforce to build the technical infrastructure required for future generations.***

2.2. The Decline of Career and Technical Education in the Nation's Schools

Historically, Career and Technical Education (CTE) courses in the nation's high schools helped many of the U.S. youth understand the career path of working in industries like construction. Unfortunately, the opportunities for high school students to take a CTE course has greatly diminished with more resources being invested in college preparation based courses. It is not unusual to see the CTE curriculum to be confined to a single high school in most school districts. A number of data points indicate that, across the U.S., CTE is in decline. Figure 2 shows that CTE credits have been declining among public high schools in all regions of the country. Rural areas report the highest number of CTE credits among U.S. public high school students, but unabated long-term shifts in U.S. populations from rural to urban areas mean that the pool of students exposed to CTE is declining. Furthermore, data from the U.S. Department of Labor show that the percentage of the experienced civilian workforce working in the construction industry is declining across all regions.



Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990, 2000, 2005, and 2009 High School Transcript Studies (HSTS).

Figure 2. Declining CTE Credits Earned in American High Schools

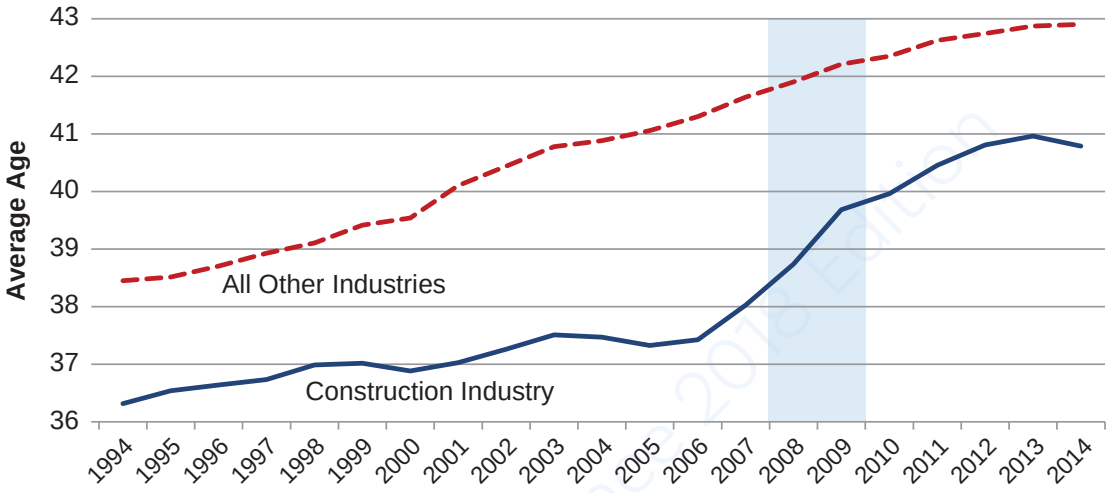
2.3. The Nation's Struggle to Meet the Demand for CTE Occupations

The U.S construction industry's struggle to find enough qualified construction craft workers is mirrored in other U.S. industries that also rely on a CTE-based workforce. The reason for much of the shortage is based on governmental policies of encouraging the pursuit of four-year college degrees, which is based on the experience that most adults with a post-secondary degree typically earn more than adults with only a high school diploma. According to Carnevale et al (2013), adults with some post-secondary education or an associate's degree earn approximately 20 percent more than adults with a high school diploma, while adults a bachelor's degree earn almost twice as much. Furthermore, projected job growth for occupation requiring only a high school degree is falling, while jobs requiring some post-secondary education are projected to increase. In addition to the economic benefits, other studies have shown that individuals with a college degree also enjoy better job benefits (e.g., health coverage, retirement, and paid vacation), greater job satisfaction, healthier lifestyles, and greater social mobility (Ma et al 2016). One question is whether the increase in number of individuals pursuing four-year college degrees is sustainable. As of 2017, outstanding student loan debt in the U.S. was approximately $1.3 trillion and forecasted to possibly reach $2.5 trillion by 2025 (Friedman 2017). Only household debt due to home mortgages currently exceeds college debt (Dynarski 2015). Furthermore college debt is increasingly affecting just the student themselves, as more and more parents report paying off their children's student loans (Ashford 2016). As a result of increasing student debt and forecasts of increasing tuition and fees among U.S. universities, the college debt burden has been described as the next financial crisis set to impact the U.S. (Foroohar 2017, Rogers and Baum 2017).

As a result of rising costs, post-secondary education in the form of a four-year degree is being questioned. All individuals need post-secondary education, but it need not be in the form of a traditional four-year bachelor's degree. Individuals do receive an income boost from completing an apprenticeship, vocational and industry certification, two-year associates' degree, and on-the-job training programs. One in four workers with licenses and certificates earns more than the average employee with a bachelor's degree, as do three in 10 workers with an associate's degree (Carnevale et al 2010). Furthermore, it is estimated that 10% of all U.S. occupations currently require a graduate degree, 20% require a bachelor's degree, while 70% require a post-secondary education that lies between a high school diploma and a bachelor's degree (Gray and Herr 2006).

2.4. An Aging Construction Workforce

Long-term structural changes have occurred in the construction craft workforce. One of them is the increase of the average age of craft workers within the industry. The rate of the increase is three times faster than the average age of workers in all other industries in the U.S. (see Figure 3). Most of this is due to young workers not entering the industry.



Source: Data Ferret – Current Population Survey, U.S. Bureau of Labor Statistics.

Figure 3. Increasing Age of the American Workforce

2.5. Impact of Skill Shortages on Project Safety

The U.S. has seen significant long-term gains in construction safety. For example, the industry's Lost Workday Case Incident Rate (LWCIR) declined from 6.8 in 1989 to 2.5 in 2008. Moreover, the construction industry's Total Recordable Incident Rates (TRIR) declined from 14.3 to 4.7 between 1989 and 2008. The question has arisen: if the skilled craft worker shortage in construction industry continues or worsens, will construction projects suffer from its impact on safety performance? A study by CII attempted to find the relationship between the difficulty of staffing craft workers on construction jobsites and TRIR. The result is noteworthy and implications are sobering.

As Table 2 shows, projects reporting a shortage of construction craft workers experienced a TRIR that was more than three times the average TRIR of projects reporting no craft-staffing difficulty (0.26 compared to 0.94). This was the experience of just 50 construction projects; however, it supports the legitimate concern that, if the workforce shortage continues to spread to other projects, it may erode the long-term gains the industry has made in preserving the health and safety of its workforce.

Table 2. Estimated TRIR of Projects Affected by Craft Labor Shortage

Craft Labor Staffing Difficulty	*No Difficulty/ Slight*	*Moderate*	*Severe/ Very Severe*
OSHA Number of Recordable Incident Cases per 200,000 Work Hours	0.26 95% Confidence Interval = (0, 1.25)	0.43 95% Confidence Interval = (0, 1.72)	0.94 95% Confidence Interval = (0, 2.84)

2.6. Impact of Craft Shortages on Productivity

Labor is the most variable and critical resource in construction operations. A significant amount of research has examined the influence of craft availability on construction productivity, primarily based on the opinions of industry experts and construction craft workers themselves (see Table 3). Although these research efforts have been conducted over different time periods, different populations, and different research methods, the importance of having a skilled and qualified workforce consistently ranked near or within the top three factors influencing craft productivity.

Recent research also empirically examined the influence of the availability of craft productivity by examining the differences in projects' productivity factors (PF) and reported craft shortages (Karimi et al 2017). The study defined the PF as the ratio of "Estimated Total Craft Work Hours" to "Actual Total Craft Work Hours" (i.e., a higher PF is desirable). Projects reporting experiencing a craft shortage also reported a PF of 0.84 compared to 1.03 among projects reporting no craft shortage. As a result of Karimi et al 2017 and other studies in Table 3, the workforce shortage will worsen the construction industries' overall productivity and ultimately increase project costs, which will initially be passed on to project owners and ultimately passed on to society in the long-term.

Table 3. Prior Research on the Influence of Labor Availability on Construction Productivity

Authors (Year)	Methodology	Summary of Results
Dai et al. (2009)	U.S. nationwide survey of 2,000 craft workers to assess the impact of 83 identified factors on labor productivity	Ten groups of factors that represent the underlying structure of the productivity were identified. Four factors were related to labor issues: Training, Craft worker qualification, Superintendent competency, and Foreman competency. The other factors were construction equipment, materials, tools and consumables, engineering drawing management, direction and coordination, and project management. In addition, craft worker qualification was identified as one of the three areas with the greatest possibility for project productivity improvement. The other two factors were construction equipment and project management.
Roja and Aramvareekul (2003)	Survey of U.S.-based owners, consultants, general contractors to identify the relative importance of factors influencing labor productivity	The factor category of Manpower was ranked as the second most influential on labor productivity among four factor categories. This factor includes experience, activity training, education, motivation, and seniority. The three other factors were management systems (ranked first), industry environment, and external conditions.
Liberda et al. (2003)	Interview with Canadian construction professionals to identify and prioritize the productivity factors	"The worker experience and skills" was ranked the second most critical factor among 51 identified factors.
Chang et al. (2007)	Quantifying the impact of schedule compression on labor productivity in 103 U.S.-based mechanical and sheet metal projects	There was a statistically significant relationship between the two ratios of "actual number of manpower at peak / estimated one" and also "actual average manpower/ estimated one" and the loss of productivity in projects (Pearson correlation = 0.398 and 0.351 respectively). These two variables can be interpreted as the level of shortage experienced in a project.
Lim and Alum (1995)	Survey among contractors in Singapore about factor affecting construction productivity	Difficulty in recruitment of supervisors and workers were the first and second most important factor among 17 identified factors.
El-Gohary and Aziz (2014)	Survey among 489 Egyptian contractors, consultants, and owners	Labor experience and skill was ranked the first and most critical factor affecting construction productivity among 30 identified factors. In addition, competency of labor supervisor ranked fifth among all factors.

2.7. Impact of Craft Shortages on Schedule Performance

When projects experience poor productivity due to craft shortages, their schedule performance suffers as well. Research that has examined the reasons why projects suffer in terms of poor schedule performance (e.g., missing project milestones and longer than expected project durations) often cites the lack of qualified craft workers as a main cause of the delay (see Table 4). Once again, this finding has been substantiated by multiple different research efforts, among different sampled projects, and different geographical locations.

Table 4 summarizes industry experts' opinion and what owners and contractors reported to have occurred on their projects. Karimi et al (2017), empirically observed the same relation when examining project data. Projects reporting experiencing a craft shortage also reported exceeding their estimated duration by over 29% versus 4.5% among projects reporting no craft shortage.

In summary, the workforce shortages hinder projects' ability to meet their schedule completion dates. Obviously, the increasing inability of contractors not being able to meeting their expected completion exposes them to liquidated damages and the inability of project owners to utilize their facilities as anticipated. In a time of increasingly shorter milestone dates and a desire for accelerated construction schedules, the reality of the workforce shortage will make these ambitions more and more difficult to obtain.

Table 4. Prior Research on the Influence of Labor Availability on Construction Productivity

Authors (Year)	Methodology	Summary of Results
Wambeke et al. (2011)	Survey of 260 U.S. construction companies about causes of variations in tasks starting time and duration	Project managers ranked "worker lack of skills/experience to perform the tasks" as the fourth leading cause of task duration variation among 50 identified factors. Overall, when also including the attitude of labor and foremen, this cause was ranked as the seventh factor. Labor force capability is also identified in the top nine factors that account for 79% of the overall variance of the task duration variations.
Abdul-Rahmaan et al. (2006)	Survey followed by interview among Malaysian clients, consultants, and contractors about delays in construction projects	Labor shortages and lack of skills were identified as the second most important major causes of delay in construction projects.
Toor and Ogunlana (2008)	Survey among 80 managers about delays in major construction projects in Thailand	Poor efficiency of supervisor and foreman was ranked as the tenth factor, and unavailability of local labor as the 35th factor, among 75 main problems causing delay in the major construction projects.
Kaming et al. (1997)	Interview with project managers working in high-rise construction projects in Indonesia	Labor productivity and skilled labor availability were ranked as the second and seventh variables among eight identified variables of time control.
Arditi et al. (1985)	Survey among Turkish public agencies and contractors	Shortage of qualified workers was ranked sixth among the eight main reasons for construction delays.
Assaf et al. (2006)	Survey among contractors, consultant and owners' firms in Saudi Arabia	Owners ranked shortage of labors and unqualified workforce as the first and second most important cause of delay among 73 identified factors. The consultants ranked shortage of labors as the second important factor. Overall, the group of labor-related factors was ranked fourth among nine groups of factors by all three groups of participants. The labor-related factors include shortage of labors, unqualified workforce, low productivity of labor, personal conflict among labor, and nationality of labors.

2.8. Why Bother? The Benefits of a Highly Skilled Workforce

Outside of developing the human resources required for the effective construction of capital facilities, there is a substantial return on the investment in workforce development across multiple dimensions of the industry ranging from reduced absenteeism and unexpected turnover to improved safety and productivity.

Benefit: Reduced Absenteeism and Turnover

Prior research (Wang et al 2010) examined the benefits of craft training among two construction firms in terms of the absenteeism and turnover rates among both the construction craft workers on both firms' projects. Both companies were engaged in heavy industrial construction work throughout North America. Company A monitored the absenteeism and turnover rates on four projects over a 15-month period among three groups of craft workers:

1. individuals who had completed their respective training program and obtained certification
2. individuals engaged in training but who had not yet achieved certification
3. individuals who had not engaged in craft training.

For the analysis, those who had completed training (Group 1) or who were in training (Group 2) were consolidated. Based on company data, the study found that craft training had a rather immediate impact on both craft turnover and absenteeism (see Table 5).

Table 5. Turnover and Absenteeism for Workers by Training Status

	Workers with No Training	*Worker Receiving Training*	*Difference*	*Z-Value*
Voluntary Turnover Rate	6.5%	0.6%	5.9%	19.12*
Absenteeism Rate	7.3%	2.5%	4.8%	9.73*

* Significant at the level of 0.05

Benefit: Improved Productivity

Quality comprehensive craft training is fundamental to the development of a skilled workforce, and a skilled workforce is essential to **productive** construction and maintenance activities. As evidence of this, prior research (CII 2007) examined the experience of one project in which the owner actively promoted skill certification of all craft workers employed on the project. The owner required craft workers to have obtained both written and performance certification within their respective trade. Over a 12-month period on one construction maintenance project, the company measured the percentage of its craft workers that had obtained their certification and the corresponding productivity performance factor on the project. In this case, the productivity performance factor was defined as the expected productivity divided by the actual productivity; thus, a productivity performance factor of less than one indicates better than expected productivity performance. Although the case study involved a limited sample size, a statistically significant relationship was found between the increase in certified craft workers and the project's productivity; as the percentage of certified craft workers increased, the project's productivity improved (i.e., performance factor decreased).

Benefit: Improved Safety

Under the guidance of the CURT Workforce Development Committee, the National Center for Construction Education and Research created the Contractor's Workforce Development Assessment (CWDA) to evaluate a contractor's internal workforce development system on a 0 to 100% score (a higher score is considered better). During its development, the CWDA was used to measure workforce development efforts across 20 different contractors along with their corresponding safety metrics. Prior CII research (2012) found that companies that scored a 90% or higher on the CWDA metric also reported significantly lower TRIR, DART rates, and EMR. Despite the small sample size, the results were statistically significant among the 90% confidence margin (see Figure 4).

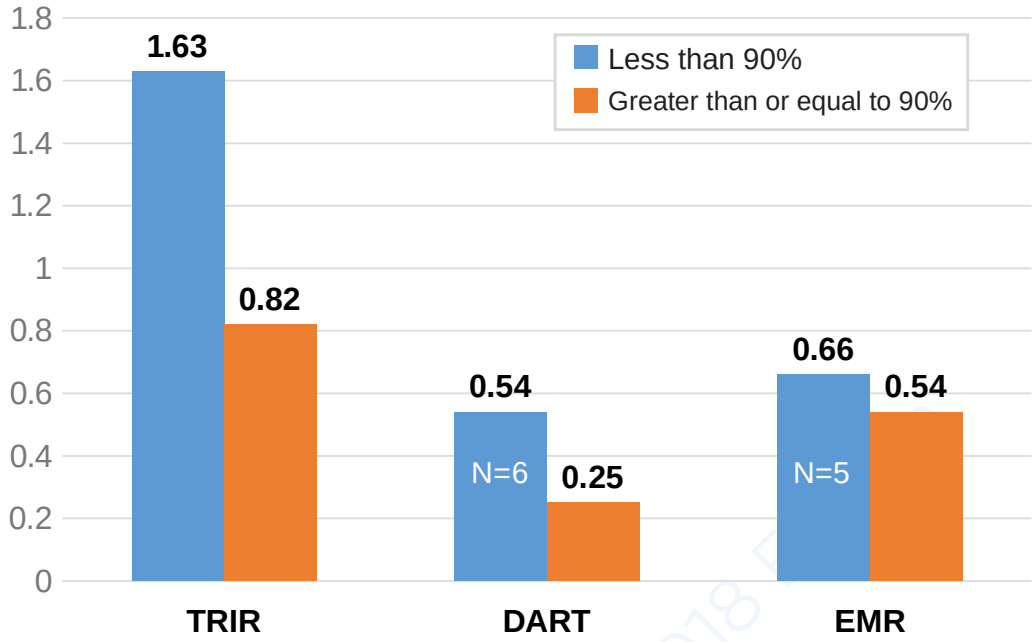


Figure 4. Improved Safety with Improved Workforce Development

2.9. Where Do We Go from Here?

The U.S. construction workforce development system can be renewed, but the effort will require the construction community, owners, and governmental agencies to work in a unified effort. RT-335 outlined the steps to at least begin down the path to make the U.S. construction workforce development system a global example. The renewal will take time. The industry and our workforce cannot wait for another decade of additional research to describe how severe the shortage has become. Rather, we need to invest our resources in developing a workforce development system that will renew our nation's infrastructure system, improve the industry's productivity, continue to improve the nation's safety performance, and accelerate construction. We need to invest our resources in developing our workforce development system into a national strategic asset.

Chapter 3
Research Methodology

As mentioned earlier, this research sought to accomplish three main objectives:

1. analyzing the current U.S. workforce development system
2. studying the workforce development best practices
3. recommending policies to help design an effective workforce development system.

In order to understand the current U.S. workforce development system, RT-335 tried to study the system from both micro and macro perspectives.

From the micro perspective, the team employed a survey methodology to understand how people make the decision to choose or continue a career in the construction industry. The survey targeted both young adults who are at the age of career selection and current craft workers. The results helped researchers understand and compare the motivational factors behind the career selection of the future workforce and the current workforce.

From the macro perspective, the research team pursued a literature review, an archival data analysis discussion panel, and case studies to gain an in-depth understanding of the system. Case studies helped the research team to identify best practices at different levels both inside and outside of the construction industry. The researchers conducted these case studies at the company, state, and county levels.

The results of the previous phases enabled the research team to achieve better understanding of the U.S. workforce development system and its strengths and weaknesses. Several discussion meetings held between the experts in our research team along with literature review helped the team to develop ideas for policy recommendations. Analytical Hierarchy Process (AHP) as a rigorous scientific way was applied to evaluate and prioritize the final policy recommendations.

The following sections described the research methodologies used in this research with more details.

3.1. Survey Methods Used in Motivation Survey

The survey method was used to understand what factors might potentially influence a person's decision to choose or continue a term career in the construction industry. The jobs included in this study are limited only to the construction trades such as carpenter, electrician, ironworker, painter, pipefitter, and welder. The theory of planned behavior was used as a theoretical framework to design the survey questionnaire.

In psychology, the theory of planned behavior is used to explain the relationship among beliefs, attitudes, and behaviors (Ajzen 1991). According to this theory, to predict an individual's behavior, we need to understand the underlying factors of intention or motivation. Ajzen (1991) suggested that the intention has three determinants: 1) attitude which indicates how much an individual has a favorable or unfavorable evaluation of the behavior, 2) subjective norm which is the perceived social pressure to perform or not to perform that behavior, and 3) perceived behavioral control which reflects the individual's perception of difficulty of performing the behavior. This theory has been used in various fields in civil engineering, such as transportation, to explain speeding behaviors of drivers in highways (Zhu et al. 2011), pedestrian's unsafe behaviors in urban traffic system (Li et al. 2009), travel mode choice behavior (Zhao 2011), and safety behavior in construction sites (Fang 2016). It also has been applied in several studies to describe career-related decisions (Gelderen et al. 2008, Zellweger et al. 2011, Chen et al. 2016).

Factors asked in the survey were identified based on a thorough literature review and discussion within a research team. Figure 5 demonstrates the theoretical framework of the survey.

The survey framework was reviewed and approved by the university Internal Review Board (IRB). After conducting a pilot test and receiving feedback, the final version of the questionnaire was developed. Both electronic and paper-based questionnaires were prepared and distributed between the months of January and September 2016.

The target population for the survey included two groups: future workforce and current workforce. To target the future workforce, the survey was distributed among young people between the ages of 15 and 24 years (i.e., the age of career selection). Surveys were collected across the country through various efforts such as recruiting events, participants in formal construction training programs, and career and technical education competitions. A total of 778 responses were collected from this group across the U.S. To target the current workforce, the survey distributed among craft workers above the age of 24 years participating in training programs across different construction companies in U.S. A total of 641 responses were collected from this group across the U.S.

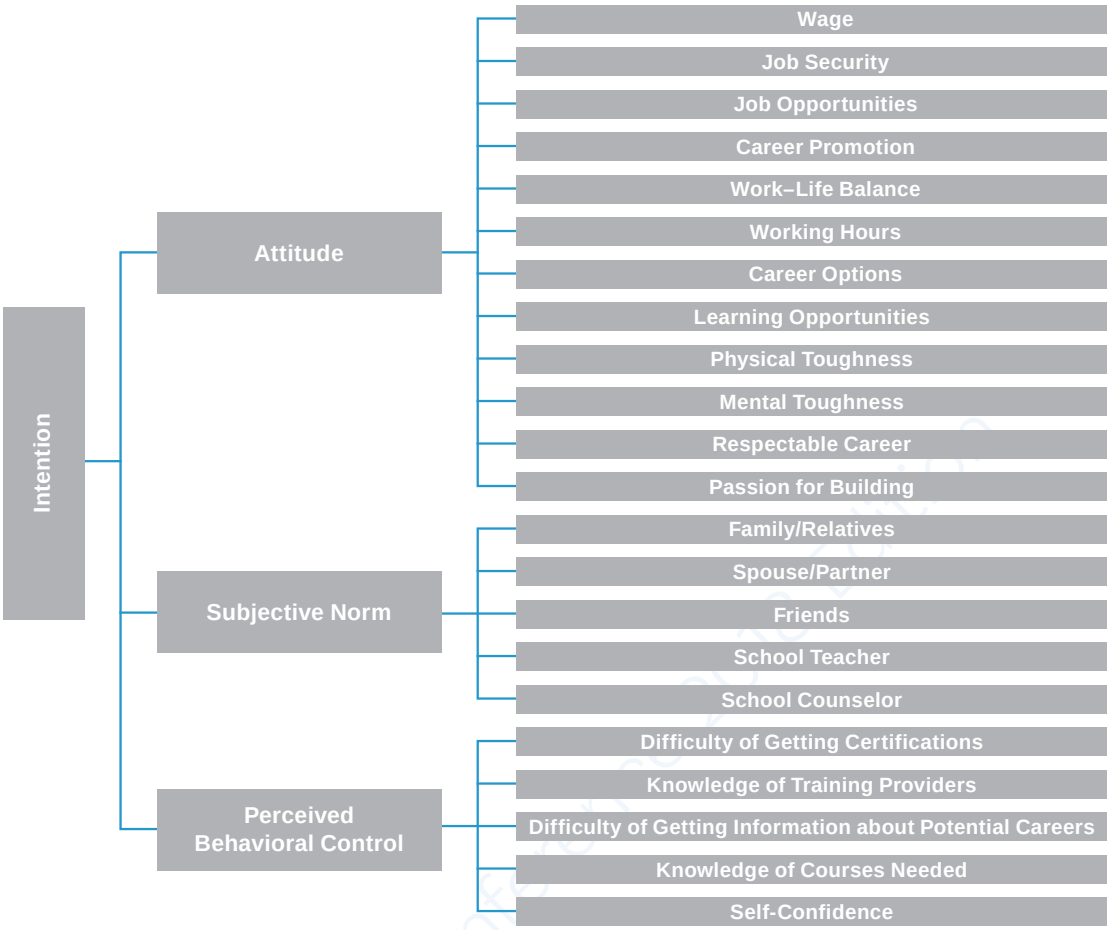


Figure 5. Survey Framework

The survey gathered information on demographic background, intention to choose to work in the construction industry, potential factors that influence attitude toward the construction industry, influence of other people important in individual's life (e.g., family, spouse/partner, friends, teachers, and school counselor), and mental factors that might control individual's decision to choose to work in the construction industry. Participants were asked to evaluate the degree to which they agree or disagree with statements related to different aspects of working in the construction industry using a seven-point Likert-type scale. The survey data were analyzed using various statistical methods including analysis of variance (ANOVA), and Structural Equation Modeling (SEM).

3.2. In-Depth Interviews

The data collected as part of the motivation survey and secondary data analysis provides a means to quantify the factors that influence career selection among individuals. The purpose of the interviews was to add richness and depth to the analytical data analysis. A multiple interview strategy was selected to overcome the limitations inherit with single interviews (Yin 2003; Frankfort-Nachmais and Nachmais 2008). The cases selected were chosen to maximize diversity across geographic, industry, government type, organizational type, and other factors.

The interviews were intended to answer the following two key questions:

1. What are the deficiencies and strengths of the current U.S. workforce development system for the construction industry?
2. What sustainable solutions could be identified that address the deficiencies and sustains the strengths? How are these solutions best implemented?

The interview candidates were selected based on recommendations from the research team, availability of contacts within the organization, and travel funding availability. All interviews were performed in-person with a target interview time of two hours with follow up communication to clarify responses or to collect additional data. When possible, the interviews were coordinated with RT-335 team meetings to maximize the number of researchers available to participate in the case studies. The RT-335 team conducted 45 separate visits over the course of the project.

Interviews were performed using the interview tool developed iteratively by the RT-335 research team across two in-person team meetings. The interviews were developed and executed based on guidance from Yin (2003). The interview tool focused on the following questions:

1. What barriers of the workforce development system have hindered your own workforce development program?
2. If all barriers were removed, what is one improvement you would make to your workforce development program?
3. What aspect(s) of the workforce development system supports your own workforce develop program the most?
4. Can you discuss the breakdown of funding for your workforce development program? Is this funding optimal?
5. Has your organization experienced significant fluctuations in wages and benefits over the past five years?
6. Has your organization found it challenging attracting new professionals into your workforce development program?

7. Do you work with any community-based organizations to help recruit trade professionals?
8. Do you work with any community colleges and other outside agencies to provide or deliver your training?
9. Where do you acquire the educational materials for your training efforts?
10. How do you continually develop and provide career progression to your workforce?

The interviews results informed the team's development of its policy recommendations.

3.3. Development and Weighting of Policy Recommendations

Previous studies, including a craft motivation survey and interviews, gave the research team a better understanding of the U.S. workforce development system and its strengths and weaknesses. The goal of this phase was to recommend policies which could make the U.S. workforce development system the best in the world. To develop and prioritize policy recommendations, the research team followed the process illustrated in Figure 6.

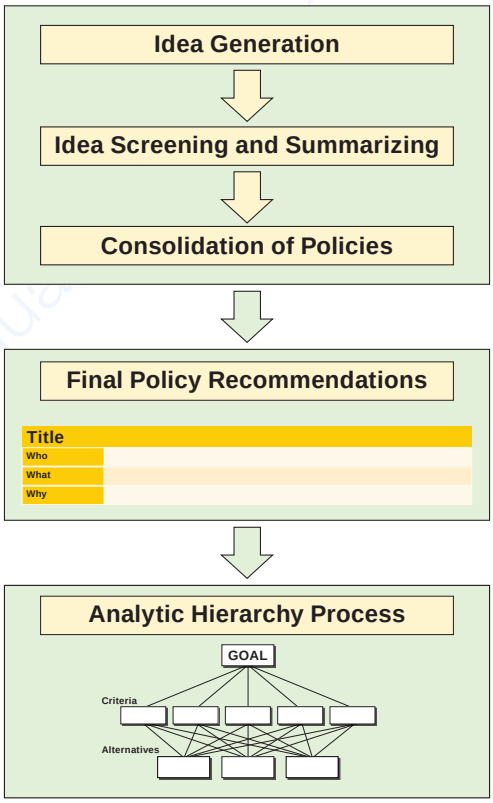


Figure 6. Overall Process of Development and Weighting of Policy Recommendations

The first phase included idea generation, idea screening, and consolidation of policies:

- During the idea generation phase, the team held four meetings between April and September 2017 to discuss possible solutions to achieve the goal. At the same time, the researchers conducted a thorough literature review in the areas of interest and presented the results to the experts in the research team to help them in this phase. During this process, the team formed 32 policy ideas.
- During the idea screening phase, the research team tried to reduce the number of policies. Wherever ideas overlapped and could be integrated, the research team merged them into single categories, in order to develop policies that were independent from one another. The results were presented to the experts and, after some revisions, consolidated into eight policies.
- During the consolidation phase, the team discussed all eight final policies on the basis of the details of each policy (what), its rationale (why), and its audience (who).

To evaluate and prioritize policy recommendations, the team applied Analytical Hierarchy Process (AHP) methodology. AHP, one of the most widely used multi-criteria decision-making techniques, was developed by Thomas Saaty (1980). The AHP methodology follows three major steps:

1. Decompose the problem into elements, then further decompose each element into sub-elements, until the process reaches the lowest level of the hierarchy.
2. Compare the relative importance of each element by doing pairwise comparisons. In this step, decision-makers provide numerical values for the priority of each element using a rating scale. If quantitative ratings are not available, decision-makers can still provide the ratings by using subjective comparison (e.g., A is more important than B).
3. Compute the priorities of elements at each level using eigenvector or least square analysis and repeat the process for each level of the hierarchy until overall weights have been calculated for all alternatives (Saaty 1980, 1994).

AHP has been successfully applied such in different domains as economics, public policy, education, marketing, and medicine (Saaty 1990, 1994). Several advantages of AHP convinced the research team to use this approach:

1. The research team faced with a problem which was complex with multiple conflicting and subjective criteria. AHP methodology can help decision-makers deal with complex decisions by decomposing them into more manageable elements, and then combining the results (Saaty 1994).
2. AHP allows a decision-maker to compare the alternatives relative to criteria. One of the AHP's strengths is to allow the decision-maker to capture objective aspects as well as subjective ones (Ishizaka and Labib 2011). Since the decision

in this research was complex, the experts subjectively evaluated all alternatives relative to criteria. AHP can also apply verbal and graphical responses to explain the subjective evaluation, which makes it more intuitively appealing and user-friendly (Ishizaka and Labib 2011).

3. AHP provides a useful index to check the consistency of the decision-maker's evaluations, thereby helping to reduce bias in the decision-making process (Saaty 1980).
4. AHP is particularly suitable for group decision-making, since it allows the group to combine the individuals' preferences into a consensus rating (Saaty and Peniwati 2013).

To decompose the decision problem into its constituent elements, the research team structured the problem into four levels: goal, criteria, sub-criteria, and policy options. The hierarchy structure of the decision model is illustrated in Figure 7.

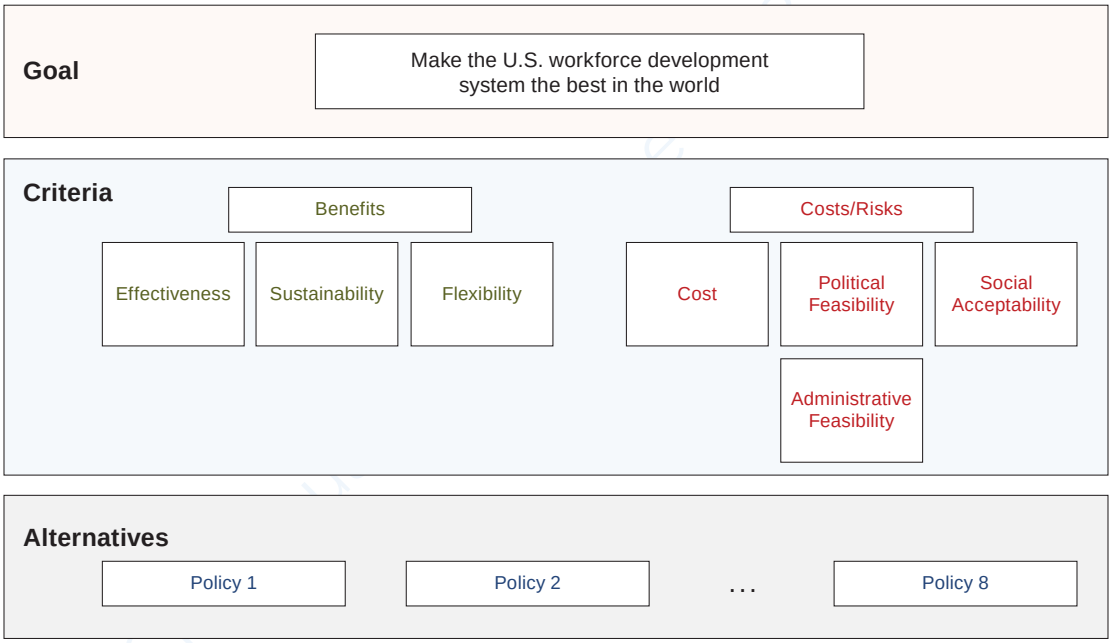


Figure 7. Analytic Hierarchy Process Model

As mentioned earlier, the goal set for the decision is to recommend policies which make the U.S. workforce development system the best in the world. AHP methodology allowed the researchers to structure the decision to apply a Benefit/Cost and Risk analysis, which is a useful way to frame the problem (Mu and Pereyra-Rojas 2017). At the criteria level, the model has benefits and cost/risk clusters, and each cluster has several sub-criteria. Through literature review and brainstorming, the team identified these sub-criteria. Kraft and Furlong (2012) suggested that to evaluate public policy

proposals, eight criteria should be considered: effectiveness, efficiency, equity, liberty/freedom, political feasibility, social acceptability, administrative feasibility, and technical feasibility. Chambers and Wedel (2005) proposed stigmatization, target efficiency, trade-offs, and sustainability. Considering the context of the decision, the research team decided to consider total of seven sub-criteria to evaluate policies:

Benefits

- **Effectiveness**: the capability to produce a desired solution to the goal.
- **Sustainability**: the decision should not actually add negative impacts or limit the capabilities of other parts of the system.
- **Flexibility**: the ability of policy to cope with possible changes in socioeconomic conditions.

Costs and Risks

- **Cost**: the cost of designing, implementing, and maintaining a policy proposal.
- **Social acceptability**: the extent to which the public will accept and support a policy proposal.
- **Political feasibility**: the extent to which elected officials accept and support a policy proposal.
- **Administrative feasibility**: the likelihood that a department or agency can implement the policy well.

The policy recommendations will be fully explained in the Results section.

For the pairwise comparisons, the experts were asked to subjectively evaluate the relative importance of items using the scale from 1 to 9 (where 9 is extremely important and 1 is equally important). As an example, if someone thinks the effectiveness is extremely more important than the sustainability, it means he or she thinks that effectiveness is nine times more important than sustainability. These pairwise comparisons should be done for both criteria and alternatives. One challenge for doing pairwise comparisons in AHP is that the number of required comparisons can be very high: $(n^2 - n)/2$ for n alternatives and criteria (Ishizaka and Labib 2011). In this model to compare all policies with respect to criteria 196 questions should be answered by respondents. This can make the process exhausting for the respondents and force them to answer questions with little time for reflection and less accuracy (Ishizaka and Labib 2011). Therefore, the incomplete pairwise comparison approach was adopted for comparing policies. By using this approach, the number of questions to be answered dropped significantly.

To implement incomplete pairwise comparison, respondents should answer seven compulsory questions for each criterion. These questions were related to upper diagonal of the comparison matrix (Ishizaka and Lusti 2006). This means respondents should compare policy one with policy two, policy two with policy three, until policy seven with policy eight. After answering these seven compulsory questions, they started to continue the comparisons until the percentage of change in absolute weights of policies from one question to another dropped below a certain threshold (Harker 1987). With this method, respondents are not required to do all the comparisons. To calculate the weights with incomplete pairwise comparison, the method suggested by Harker (1987) was used. To implement this approach in practice, the research team developed a decision support system using Microsoft Excel and Visual Basic. The system automatically updated the weights of policies after answering each question, informed the respondent to stop answering after reaching the threshold and calculated the inconsistency ratio and suggested the options to improve the inconsistency ratio.

For the purpose of our research, 11 subject matter experts, with an average of 28 years of industry experience, participated in the AHP process. All individuals were currently involved in workforce development in capacities as training directors, human resource directors, and curriculum development.

The final weights for AHP model which represent the preferences of all experts in the group were calculated using mathematical aggregation. In this method the geometric mean of individual evaluations are used as elements in the pair-wise matrices and then priorities are computed (Saaty and Vargas 2005).

Chapter 4

Results

4.1. Survey Results

The goal of the survey to understand how people make decision to choose or continue a career in the construction industry. As described earlier, the target population for the survey included two groups:

1. The future workforce, including young people between the ages of 15 and 24, who were targeted through various efforts such as recruiting events, formal construction training programs, and career and technical education competitions
2. The current workforce, including craft workers above the age of 24, who participate in training programs with different construction companies across the U.S. The following sections will discuss the results of the survey.

4.1.1. Future Workforce

Figure 8 offers some demographic information about the group that participated in this survey.

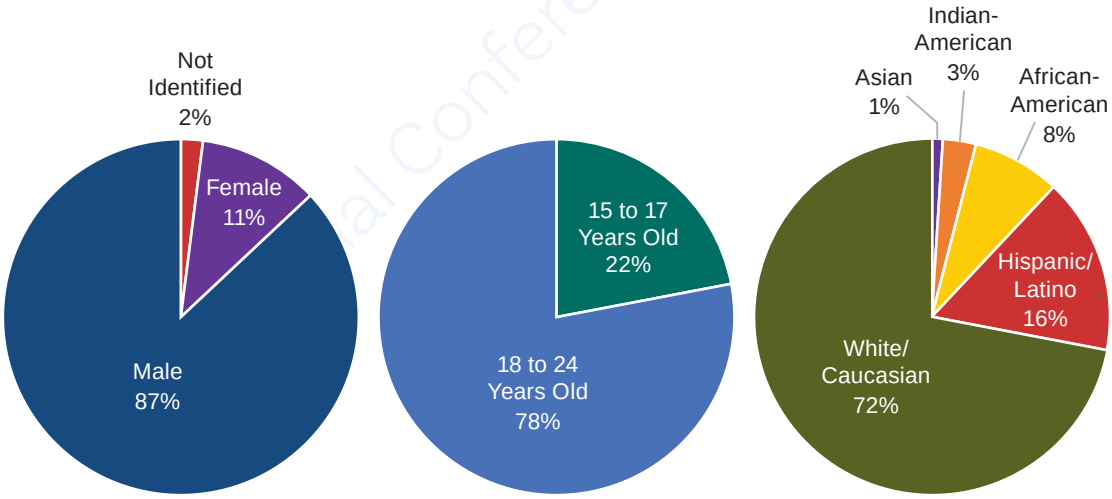


Figure 8. Distribution of Respondents Based on Gender, Age, and Ethnicity

Most of the subjects in the sample (86%) reported that they took career and technical education classes or courses related to either construction or other industries (e.g. automotive, aviation, hospitality, or health) during high school. Figure 9 shows the distribution of respondents based on work experience in construction-related jobs.

Moreover, most of the subjects in our sample (69%) reported that they have more than five years of work experience in any construction-related jobs. Only 6% have less than one year of work experience.

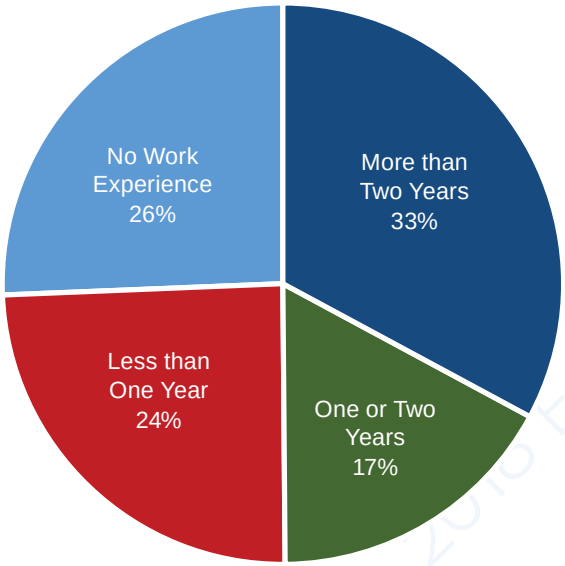


Figure 9. Distribution of Respondents Based on Work Experience

Intention and Work Experience

Respondents were asked to indicate how likely they are to choose a career in the construction industry. ANOVA analysis proved that people with different levels of exposure to any construction-related jobs are significantly different in terms of intention to choose a career in the construction industry (see Table 6).

Table 6. ANOVA Analysis of Intention Based on Work Experience

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	205.136	3	68.379	31.508	.000
Within Groups	1668.9	769	2.17		
Total	1874.03	772			

Robust Tests of Equality of Means

	F	df1	df2	Sig.
Welch	27.672	3	399.597	.000
Brown-Forsythe	32.755	3	684.984	.000

Moreover, *post hoc* comparisons using the Tamhane's T2 test indicated that the mean of intention for the group with no work experience (mean= 4.89) was significantly lower than the other groups (see Figure 10). The mean of intention for the group with less than one year of work experience (mean= 5.77) was also significantly different than other groups. However, the mean score for the group with one to two years of work experience (mean= 6.18) did not significantly differ from the group with more than two years of work experience (mean= 6.13). The results show that just one year of work experience in the construction-related jobs has a positive and significant effect on the individual's intention to choose to work in the industry.

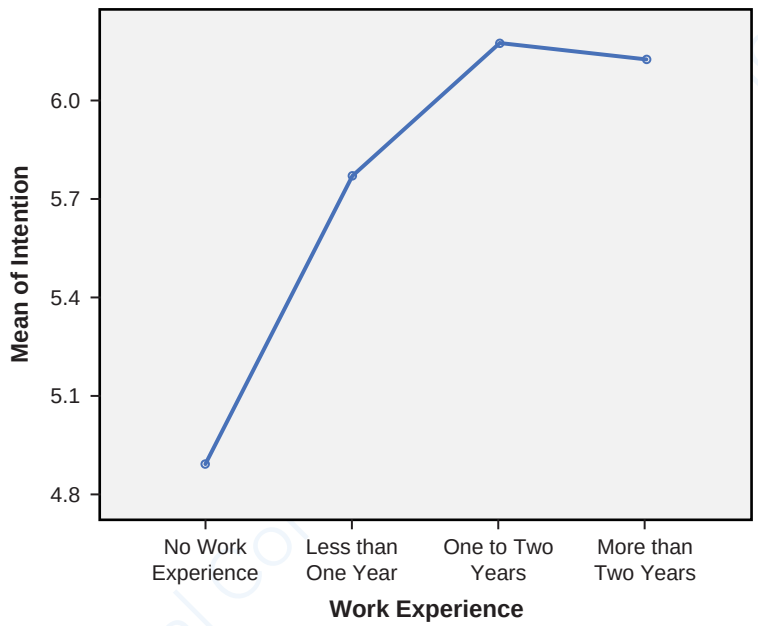


Figure 10. Intention and Work Experience

Statistical analysis indicates that in our sample, males (mean= 5.81) are more likely to choose a career in the construction industry than females (mean=5.12) regardless if they have work experience in construction-related jobs (sig. level = 0.000).

Among young people with some level of work experience in the construction-related jobs, people between the ages of 18 and 24 years (mean= 6.08) are more likely to pursue a career in the construction industry than people between the ages of 15 to 17 years (mean=5.22, sig. level= 0.000). This could be alarming for the construction industry and indicate that the industry is even less attractive to upcoming generation. However, we did not see any significant difference across these two groups when they have no work experience.

Attitude toward Working in the Construction Industry

As mentioned earlier, according to the theory of planned behavior, one determinant of intention is attitude. In this research, we measured the overall attitude and its 13 components. The components of attitude measured in our research are mentioned in Table 7.

Table 7. Overall and Components of Attitude for People with and without Prior Work Experience

	Without Work Experience		With Work Experience	
	Males	Females	Males	Females
Overall Attitude	5.53	5.25	5.99	5.47
Wage	5.57	5.63	5.74	5.83
Job security	4.97	4.89	5.13	5.11
Job opportunities*	2.84	2.88	2.69	2.92
Career promotion	5.39	5.00	5.50	5.25
Benefits to society	6.06	5.97	6.19	6.08
Work-life balance*	4.32	4.22	4.37	4.26
Working hours*	5.31	5.12	5.41	5.33
Career options	5.74	5.83	5.91	5.97
Learning opportunities	6.00	6.15	6.15	6.24
Physical toughness	5.56	5.13	5.77	5.08
Mental toughness	5.18	4.70	5.29	4.91
Respectable career	5.96	5.72	6.06	5.73
Passion for building	6.03	5.30	6.33	5.50

* The components with asterisk were asked with negative questions.

We found that overall attitude is highly correlated with the intention (Pearson Correlation Coefficient= 0.873, sig. level = 0.000). For those individuals who have either no or some work experience in any construction-related jobs, we found that the overall attitude of males and females is not significantly different. But in terms of components of attitude, there are several differences. Females believe that there are less opportunities for career promotion in the industry than males (sig. level = 0.017). Interestingly, females think that working in the construction industry is less physically demanding than males (sig. level = 0.029). In comparison to male, females perceive that working in the construction industry is less mentally challenging (sig. level = 0.023). Passion for building measures the individual's inherent passion and interest to work with hand and build things. In this regard, we observed that males who participated in our research, are more passionate to build things than females (sig. level = 0.001).

We did similar analyses among males and females with some work experience in construction-related jobs. Here, we found that males have significantly more positive attitude toward working in the construction industry than females (sig. level= 0.012). Again, females evaluated working in the industry less physically and mentally challenging than males (with respectively significance levels of 0.000 and 0.021). In addition, as women gain more exposure to the industry, they believe less than men do that working in the construction industry is a respectable career (sig. level = 0.035). Similar to previous results, males reported that they have more passion for building things than females (sig. level = 0.000).

Subjective Norm

The respondents were asked to rate the degree to which family, spouse or partner, friends, school teacher, and school counselor encourage them to choose a career in the construction industry. We found that there are significant correlations between the intention and the degree of support they receive from these people (Table 8). We also examined if these correlation coefficients are significantly different. To do this, we used the statistical method developed by Steiger (1980) to test differences between nonindependent correlations. The results indicate that there is no significant difference across correlation coefficients of intention and family support, intention and spouse support, and intention and friends support. However, these coefficients are significantly different from correlations between both intention and school teacher support and intention and school counselor support (sig. level < .05, Lee and Preacher 2013). The results confirm that the role of family, spouse or partner, and friends are more important than others. These findings are compatible with previous studies indicating the role of family and friends in individual's career decision (Taylor 2005, Zafar 2011, Granitz et al. 2014). Interestingly, people with at least one family member in the construction industry are more encouraged by their families to choose a career in construction (sig. level= 0.002).

Table 8. Pearson Correlation Analysis of Intention and Subjective Norm

	Intention	Family and relatives	Spouse or partner	Friends	School teacher	School counselor
Intention	1	.370**	.347**	.350**	.255**	.190**
Family/relatives		1	.665**	.627**	.567**	.495**
Spouse/partner			1	.672**	.535**	.606**
Friends				1	.645**	.535**
School teacher					1	.698**
School counselor						1

**. Correlation is significant at the 0.01 level (2-tailed).

Perceived Behavioral Control

In this section, we analyzed respondents' perception toward possible barriers that they might face in choosing a career in the construction industry. Results indicate that having knowledge about construction training providers and courses needed to take to become a credentialed craft professional and confidence are significantly correlated with intention (Table 9). Young people with work experience in construction-related jobs are more likely to have a good knowledge of construction craft or apprenticeship programs (sig. level= 0.000) and are more likely to have good knowledge of courses required for becoming a craft professional (sig. level= 0.000). Hodkinson and Sparkes (1997) use the term "pragmatic rationality" to explain the youth career decision making. From this view, career decision is highly influenced by contextual factors such as interaction with other people, experiences, family influences, information derived from media, stereotypical occupational images portrayed in film and entertainment, and emotional propensity (Hodkinson and Sparkes 1997). In this regard, our findings demonstrate that the construction industry can overcome at least some of the mental barriers by providing more information to the public about how an individual can enter the industry and become a successful craft worker.

As illustrated in Table 9, intention has a high correlation with self-confidence (0.591). Self-efficacy theory considers confidence as a strong predictor of a behavior (Bandura 1977). Also, Figure 11 shows that as people become more experienced in the construction industry, they become more confident in their abilities to be successful in the construction industry. This is also compatible with self-efficacy theory which implies that confidence can create a positive spiral in which persons with high confidence become more envolved in their tasks and then, in turn, strengthen their performance, which further increases confidence (Bandura 1977).

In addition, it is observed that young males (mean= 6.10) are generally more confident in their abilities to be successful in the construction industry than young females (mean= 5.66) with a significance level of 0.005. Interestingly, those who have at least one family member working in the construction industry, have more confidence in their abilities to be successful (sig. level = 0.006). This finding confirms that family members who work in an occupation can be a role model in that job for young individuals (Taylor 2005).

Table 9. Pearson Correlation Analysis of Intention and Elements of Perceived Behavioral Control

	Intention	Difficulty of getting certifications	Knowledge of construction training providers	Difficulty of getting information about potential careers	Knowledge of courses needed to become craft professional	Self-confidence
Intention	1	.009	.273**	–.051	.336**	.591**
Difficulty of getting certifications		1	–.178**	.402**	–.040	-.096**
Knowledge of construction training providers			1	–.215**	.574**	.338**
Difficulty of getting information about potential careers				1	–.149**	-.134**
Knowledge of courses needed to become craft professional					1	.438**
Self-confidence						1

**. Correlation is significant at the 0.01 level (2-tailed).

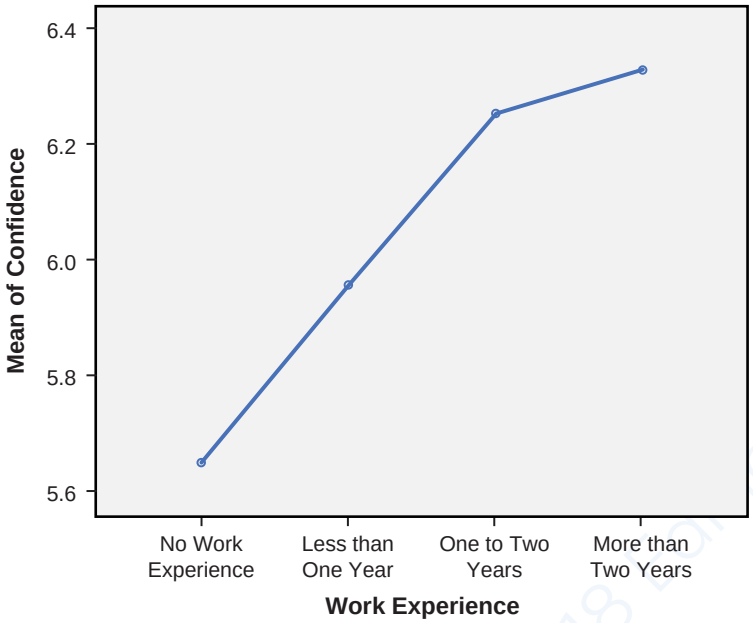


Figure 11. Confidence and Work Experience

4.1.2. Current Workforce

The gender, age distribution, ethnicity, and work experience of the group that participated in this survey is depicted in Figures 8 and 9 at the beginning of this chapter. We further categorized the respondents based on generations and education. Figure 12 shows the distribution of respondents based on different generations: Generation Y (born 1977 to 1995), Generation X (born 1965 to 1976), and Baby boomers (born 1946 to 1964). Figure 13 illustrated the distribution of people in terms of the highest level of education they had attained.

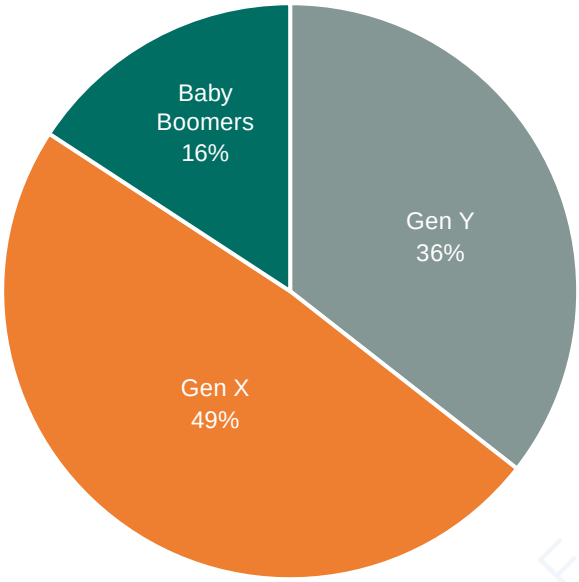


Figure 12. Distribution of Respondents Based on Generation

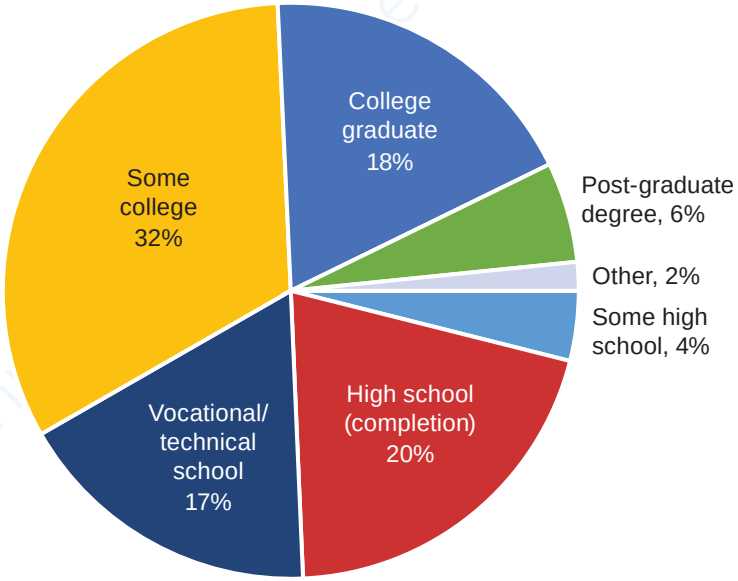


Figure 13. Distribution of Respondents Based on Highest Level of Education

Attitude toward Working in the Construction Industry

Overall attitude measures the degree to which the respondents believe that pursuing a career in the construction industry seems a good decision for them. Our analysis showed that it is highly correlated with the motivation of individuals to continue their career in construction (Pearson correlation = 0.711, sig. level = 0.000).

We were interested to know if people's perception toward different aspects of working in construction varies among females and males. Although we could not find any significant differences in overall attitude between the two groups of females and males, there are some differences in terms of components of attitude (see Table 10).

Table 10. Components of Attitude Based on Gender

Females		Males	
Wage	6.07	Passion for building	6.31
Learning opportunities	5.94	Respectable career	6.15
Passion for building	5.90	Benefits to society	6.11
Respectable career	5.87	Learning opportunities	5.98
Benefits to society	5.82	Physical toughness	5.85
Career option	5.76	Career option	5.83
Physical toughness	5.45	Wage	5.82
Career promotion	5.34	Mental toughness	5.51
Mental toughness	5.24	Career promotion	5.29
Job opportunities	5.03	Job opportunities	5.09
Job security	4.79	Job security	4.82
Work-life balance	3.16	Work-life balance	3.08
Working hours	2.16	Working hours	2.49

Statistical analysis indicated that compared to females, males are more likely to perceive the construction industry as providing jobs that benefit the society (sig. level = 0.043). Generally, females are more concerned about long working hours than males (sig. level = 0.022). Furthermore for females in our sample, it is less physically tough to work in construction than males (sig. level = 0.005). We also observed that men are more likely than women to believe that working in the construction industry is a respectable career (sig. level = 0.029).

Passion for building measures the individual's inherent passion and interest to work with hand and build things. In this regard, we found that males who participated in our research are more passionate to build things than females (sig. level = 0.011).

It is worth noting that both males and females gave relatively low scores among the following items: working hours, work-life balance, and job securities. These results indicate that both groups perceived that working in construction requires long working hours and challenges in the balance between work and life. They also perceived that the risk of becoming unemployed in the construction industry is relatively high.

The results of this section show how three generations perceive different aspects of working in the construction industry. Table 11 summarized the results. We find that in just five out of 13 components of attitude have no statistical difference across different generations. These components include wage, work-life balance, working hours, physical toughness, and respectable career. The results indicate different generations are relatively satisfied with the level of wages offered by the industry. Also, the respondents indicate that by entering construction, they can have a respectable career. On the other hand, there is a consensus that working in the construction industry makes it challenge to balance work and personal responsibilities. Likewise, all generations believe that working in the industry demands long working hours and high levels of physical endurance.

But in terms of other factors, Generation X has a relatively pessimistic approach toward working in construction. Generation X has a less favorable evaluation of job security, job opportunities, career promotion, benefits to society, and learning opportunities provided by construction. In addition, people in our sample from Generation X rated themselves less passionate for building things. On the other hand, Generation Y evaluated working in the industry as less mentally challenging than other generations.

Table 11. Components of Attitude for Different Generations

Components of Attitude	Generations	Sample Size	Mean	F	P value
Wage	Gen Y	228	5.87		
	Gen X	311	5.83	0.115	.891
	Baby Boomers	100	5.86		
Job security	Gen Y	228	5.07		
	Gen X	311	4.63	6.414	.002
	Baby Boomers	101	4.76		
Job opportunities	Gen Y	228	5.06		
	Gen X	310	4.98	3.173	.043
	Baby Boomers	101	5.41		
Career promotion	Gen Y	228	5.52		
	Gen X	311	5.09	7.641	.001
	Baby Boomers	101	5.35		
Benefits to society	Gen Y	228	6.22		
	Gen X	310	5.95	5.390	.005
	Baby Boomers	101	6.10		
Work-life balance	Gen Y	228	3.22		
	Gen X	311	3.03	1.732	.178
	Baby Boomers	100	2.90		
Working hours	Gen Y	228	2.40		
	Gen X	311	2.45	1.064	.346
	Baby Boomers	100	2.59		
Career option	Gen Y	227	5.98		
	Gen X	310	5.75	4.404	.013
	Baby Boomers	101	5.69		
Learning opportunities	Gen Y	228	6.11		
	Gen X	311	5.88	3.353	.036
	Baby Boomers	99	5.98		
Physical toughness	Gen Y	228	5.78		
	Gen X	308	5.83	.195	.823
	Baby Boomers	101	5.82		
Mental toughness	Gen Y	228	5.32		
	Gen X	311	5.59	3.724	.025
	Baby Boomers	101	5.50		
Respectable career	Gen Y	228	6.21		
	Gen X	311	6.05	1.667	.190
	Baby Boomers	101	6.14		
Passion for building	Gen Y	228	6.38		
	Gen X	311	6.16	4.246	.015
	Baby Boomers	101	6.34		

Subjective Norm

The respondents were asked to rate the degree to which significant others, including family, spouse or partner, friends, and training program instructors encouraged them to pursue a career in the construction industry. We find that there are significant correlations between the intention and the degree of support they receive from these people (Table 12). We used the statistical method developed by Steiger (1980) to test if these correlation coefficients are significantly different. The results indicate that there is no significant difference across these correlation coefficients. The results suggest that the influences of family, spouse or partner, friends, and training program instructors on individual's career decision are relatively the same. The correlations between supports received from family, spouse or partner, friends and instructors are also high. This means that they received relatively consistent support from their social environment.

Table 12. Pearson Correlation Analysis of Intention and Subjective Norm

	Intention	Family and relatives	Spouse or partner	Friends	Training program instructors
Intention	1	.238**	.195**	.258**	.199**
Family and relatives		1	.647**	.611**	.515**
Spouse or partner			1	.593**	.557**
Friends				1	.556**
Training program instructor					1

**. Correlation is significant at the 0.01 level (2-tailed).

Perceived Behavioral Control

To understand the effect of perceived behavioral control on the intention to pursue a career in construction, we investigated the individuals' beliefs about difficulty of getting the required certificates and acquiring information on training programs and potential careers in construction. We also wanted to know the effect of self-confidence in their abilities and skills on their intention.

With respect to difficulty of getting certifications, no correlation was found between this factor and intention. In addition, we did not find any correlation between intention and difficulty of obtaining information about potential careers in the industry. One possible explanation is that most people in our sample had more than five years of work experience. So, it is highly probable that they already know the possible career opportunities.

As Table 13 indicates, the two factors of knowledge of construction training providers and knowledge of courses needed to become craft professionals have statistically significant correlations with the intention. In addition, the knowledge of courses has highly positive correlation with knowledge of training programs and negative correlation with difficulty of getting information about potential careers. This reflects that those who have a clear image of their career path have a better knowledge of their development opportunities. Considering the fact that opportunities to learn and grow at workplace are highly important to construction workers as our study results suggest, it is not surprising that those who have a better knowledge of development opportunities have higher intention to stay in construction.

The intention is also correlated with self-confidence. This result is consistent with self-efficacy theory which considers confidence as a strong predictor of a behavior (Bandura 1977). According to this theory, self-efficacy has a central effect on human motivation and performance outcomes. Among these outcomes, achievement pursuit, development of intrinsic motivation, and successful career management can be mentioned (Bandura 1982).

Table 13. Pearson Correlation Analysis of Intention and Elements of Perceived Behavioral Control

	Intention	Difficulty of getting certifications	Knowledge of construction training providers	Difficulty of getting information about potential careers	Knowledge of courses needed to become craft professional	Self-confidence
Intention	1	.000	.117**	–.02	.209**	.302**
Difficulty of getting certifications		1	–.268**	.457**	-.178**	–.012
Knowledge of construction training providers			1	–.349**	.525**	.286**
Difficulty of getting information about potential careers				1	–.207**	-.090**
Knowledge of courses needed to become craft professional					1	.338**
Self-confidence						1

**. Correlation is significant at the 0.01 level (2-tailed).

4.1.3. Career Decision Making Model

The team used the Theory of Planned Behavior to understand how attitude, social norms, and perceived behavioral controls affect the intention of choosing to begin or continue a career in construction. The goal of this section is to consider all factors suggested by this theory and, at the same time, to model the career decision-making process. This section will also compare the decision-making models of future and current workforces and understand their differences and similarities.

To analyze the whole decision model, one cannot use traditional statistical methods, since they cannot consider all causational and correlational relationships at the same time. For this reason, the team used Structural Equation Modeling (SEM), a set of statistical methods that make it possible to fit networks of constructs to the data. The team also elected to use SEM because the model has latent or unobservable variables (e.g., attitude, social norms, and perceived behavioral controls) which cannot be measured directly, but can be measured through observable variables (e.g., perceptions toward wage, learning opportunities, and so on).

The career decision model for the future workforce is illustrated in Figure 13. Attitude toward the construction industry is the most important factor on individuals' intention to choose a career in construction, and the most important component of attitude is passion for building – the inherent interest of an individual to build things. The results predict that young people who are more interested in building things are more likely to choose a career in construction. The second most important factor is the learning opportunities offered by the industry. In the two next most important factors, young individuals value benefits to society and career promotion. This team's findings suggest that the new generation entering the industry places a significant emphasis on having a meaningful job that allows one to learn more and exercise one's capacities, rather than valuing usual benefits such as job security and high wages. The next most important construct is perceived behavioral control, which is mainly driven by self-confidence. Social norms have the least influence on young adults' intention to choose a career in the construction industry. Spouse or partner, family, and friends have more influence on an individual's career decision than do school teacher and counselor.

Figure 14 illustrates the decision model for the current workforce. In this group, the most influential factor on individuals' intention to continue their career in construction is their attitude toward the construction industry. Career promotion (vertical movement along the career path), learning opportunities, career options (horizontal movement in the career paths), and wage are the most significant factors driving the attitude toward working in construction. Similar to the future workforce, the next important construct is perceived behavioral control. But the relative importance of this construct for the current workforce is not as important as for the future workforce. Perceived behavioral

control for the current workforce is mainly driven by the individual's confidence in his or her abilities to become a successful person in the industry. For the social norm, the level of support an individual receives from spouse or partner and friends the most significant reasons to remain in the industry.

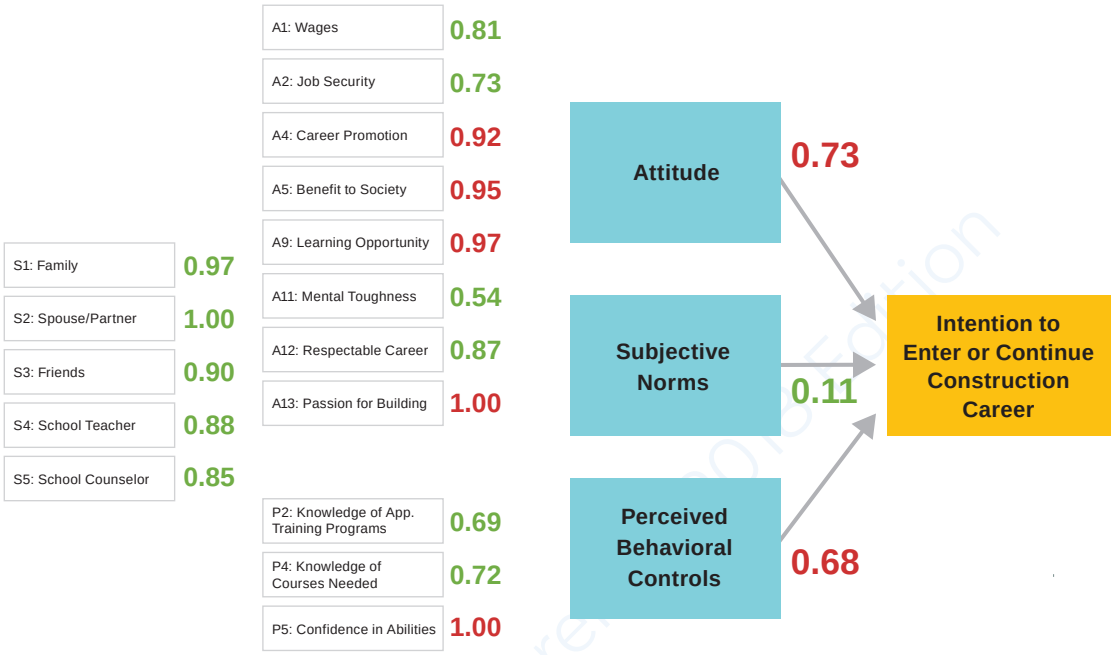


Figure 13. Career Decision-Making Model for Future Workforce (15 to 24 Years)

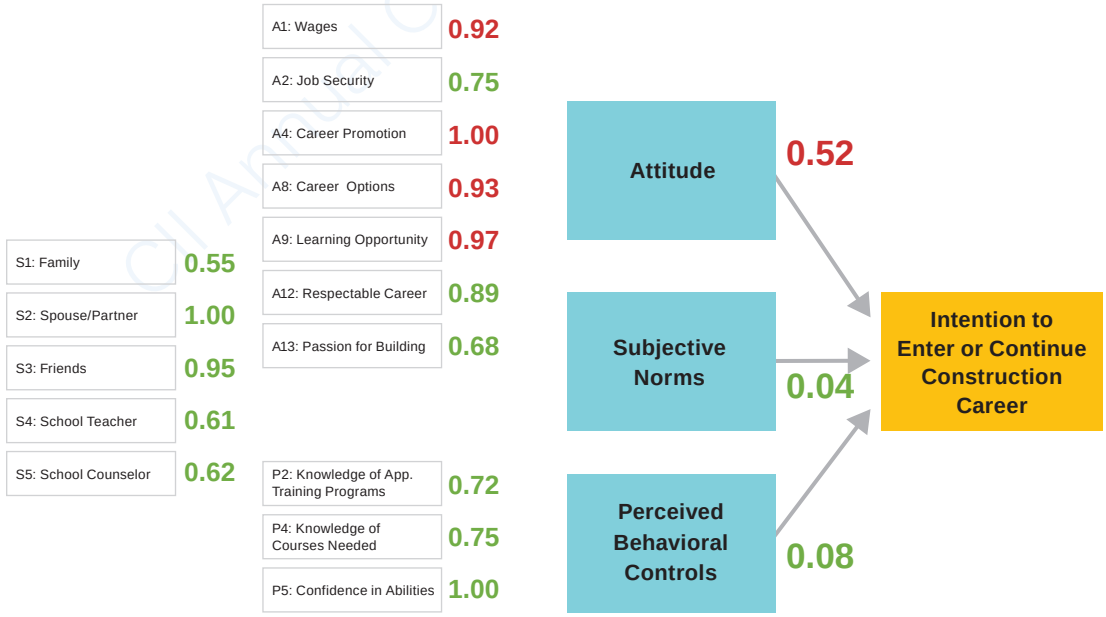


Figure 14. Career Decision-Making Model for Current Workforce (Older than 24)

4.1.4. Summary of the Results

One of the challenges facing the construction industry is to attract new talents in order to sustain the availability of qualified workforce. To attract young adults to working in the into the construction trades, the industry needs to understand the underlying factors behind people's decision to select a long-term career in the construction industry. The main findings of the survey for future workforce are as below:

1. The overall attitude toward working in construction is highly correlated with the intention to choose a career in the industry. We also identified the components of the attitude and quantify the relative strength of these components. The results indicate that although wage level is important, there are other important factors that influence attitude. We found that the most important component of attitude is passion for building.
2. We found that the upcoming workforce gives the highest value to three factors of learning opportunities, benefits to society, and career promotion. These findings are important because they can guide the construction companies regarding the aspects of the jobs that should be emphasized in their recruitment activities. In addition, these findings have implications for the way construction companies are treating young adults who have just entered the industry. In one study, Uwakweh (2006) found that construction apprentices' motivation to pursue a career in construction was low. To keep the young talent in the industry, construction companies should foster a workplace environment which is compatible with the expectations of the new generation.
3. Our results clearly show the importance of early exposure to construction-related jobs on the attitude and intention of young adults toward working in construction. Just one year of work experience can significantly improve the intention. This exposure to the industry helps young adults to better understand the job lifestyle and the image of work environment which are critical to career decision-making process (Taylor 2005). The construction industry can facilitate the exposure to the industry by providing more on-the-job training opportunities, apprenticeship, and pre-apprenticeship programs for young adults, especially in secondary education, and engaging in vocational training.
4. There are some differences between males and females in terms of components of attitude. One important difference is that males put more emphasis on passion for building than females do. Moreover, females perceive jobs in construction less mentally challenging. Again, these findings can help the industry understand how to communicate with males and females.
5. The results of this study also confirmed the influence of family members and friends in the decision making process. Especially, those who have at least one family member working in the industry become more encouraged to choose a career in construction. It indicates that if the industry wants to attract more young talents to construction, it also needs to influence their parents' perception toward construction.

6. Those who have a high motivation to choose a career in construction industry are also more confident about their future success in the industry. So, it is important to increase self-confidence in young adults about their abilities. Self-efficacy theory provides some strategies to achieve this purpose. These strategies include enactive mastery, vicarious modeling, and verbal persuasion (Bandura, 1997). Enactive mastery refers to the act of practicing in a task in order to improve one's confidence. Gaining relevant experience with the task or job can highly influence the feelings of self-confidence by improving self-competence toward a task. This is compatible with our results showing that as people become more experienced in the construction industry, they become more confident in their abilities to be successful in construction. This can again highlight the importance of providing on-the-job training in the construction industry. According to Bandura (1997), vicarious modeling occurs when an individual becomes more confident by seeing someone else doing the task. The industry can adopt this strategy by featuring those young adults who are successful in construction through advertising campaigns. Also, the industry can boost self-confidence by establishing formal and informal mentorship programs in which young adults can learn from someone who has the necessary experience (Bandura 1977, Saffold 2005). The third source of confidence is to convince an individual that she or he has the skills necessary to be successful (verbal persuasion). This highlights the role of supervisors who are responsible for young workers who just arrived to the industry. They need to improve young adults' self-confidence by giving them positive feedbacks.

To retain its talents, the construction industry needs to understand the craft workers' motivational factors. This understanding helps the companies to effectively manage human resource practices to keep craft workers motivated. This research investigated how craft workers perceive working in construction and how this perception influences their intention to pursue a long-term career in the industry. We also examined how people's attitude vary according to their gender and generation. The main findings of the survey for current workforce are as below:

1. The results indicate that the intention is highly correlated with the overall attitude. We find that seven components influence the overall attitude: career promotion, learning opportunities, career options and wage. The implication for the industry is that we should not underestimate the intrinsic drivers of motivation. Although monetary rewards are important as the results of our study suggest, but they are not sufficient to serve as the primary factor to motivate craft workers to work in construction. The construction firms need to foster a work environment that encourages and promotes employees' learning and development and provides more meaningful jobs. In addition, our results indicate that construction workers appreciate having a flexible career which allows them to develop and use different sets of skills. It might also help them reduce the risk of being unemployed by increasing their marketable skills.

2. Our study show differences in viewpoints based on gender. Females and males do not perceive some aspects of working in construction similarly. Craft women in our sample rate benefits to society, working hours, and having respectable career lower than men. This might be due to the nature of the jobs assigned to women in the industry. Previous Studies shows that the construction industry was not as successful as other male-dominated industries to attract women (National Women's Law Center 2012). Since attracting women to the industry could be one of the remedies of current workforce shortages in the industry, construction companies need to customize their human resource initiatives to attract more women.
3. In terms of generation, we found that Generation X has a relatively pessimistic attitude toward the industry in several aspects. Since this generation includes the core body of the current workforce in the industry, construction companies must pay special attention to them. Considering the knowledge and skills accumulated in this generation, losing people from this generation could be costly for companies.
4. We also find that the decision to stay in the industry is not an isolated decision. This decision is influenced by the social environment around the craft workers. Nevertheless, we did not find any significant difference between influence of different parties (i.e., family, spouse or partner, friends, and instructors). This means that receiving a consistent positive or negative feedback can influence the decision to stay or leave the industry.
5. Finally, the effect of perceived behavioral control was examined. We found that those who have a better knowledge of development opportunities have higher intention to stay in construction. This shows that the industry not only should provide better development opportunities for craft workers but also should better communicate them to the people. Moreover, self-confidence is an important factor influencing the intention. If people have more confidence on their abilities to become successful in construction, they are more willing to pursue their career in the industry. Construction firms can design mechanisms to effectively improve self-confidence among their workers. Giving feedback through formal mechanisms such as performance management systems or informal mechanisms such as mentorship programs can be effective ways to ensure craft workers about their abilities and identify possible areas for improvements. In order to improve feedback effectiveness, it is recommended that feedback mechanisms be accompanied with learning and development opportunities (Dessler 2013). In this way construction companies can increase self-confidence and motivation through creating an amplifying loop by giving appropriate feedback and providing learning opportunities to strengthen the effect of each other.

4.2. Interview Results

European organizations are classified by country.

North American Companies and Associations

1. Associated Building Contractors New Orleans/Bayou Chapter (St. Rose, LA)
2. Associated Building Contractors Pelican Chapter (Baton Rouge, LA)
3. Associated General Contractors of Louisiana (Baton Rouge, LA)
4. Association of Career and Technical Education (Washington, DC)
5. Austal USA (Mobile, AL)
6. Birmingham Business Alliance (Birmingham, AL)
7. Central Gulf Coast Industrial Alliance (Gulfport, MS)
8. E3 Washington (Washington, DC)
9. Flour Craft Training Center (Pasadena, TX)
10. Go Build Alabama (Birmingham, AL)
11. Ingalls Shipbuilding (Pascagoula, MS)
12. International Association of Bridger, Structural, Ornamental, and Reinforcing Ironworkers Local 86 (Tukwila, WA)
13. International Association of Bridger, Structural, Ornamental, and Reinforcing Ironworkers Local 720 (Alberta, Canada)
14. Louisiana Economic Development
15. Opportunity America (Washington, DC)
16. Power Up: It's a Mother Daughter Thing! (Birmingham, Alabama)
17. Skills USA (Washington, DC)
18. Southern Company (Birmingham, AL)
19. Southwest Alabama Workforce Development Council (Mobile, AL)
20. The Boeing Company (North Charleston, SC)

Federal Government Organizations

1. Department of Education (Washington, DC)
2. Department of Labor Assistant Secretary (Washington, DC)
3. Department of Labor Job Corps (Washington, DC)
4. Department of Labor Office of Apprenticeship (Washington, DC)

5. Department of Labor Occupational Safety and Health Administration (Washington, DC)
6. Federal Highway Administration (Washington, DC)
7. House Committee on Education and the Workforce (Washington, DC)

State Government Organizations

1. Louisiana Community and Technical College System (Baton Rouge, LA)
2. Louisiana Economic Development (Baton Rouge, LA)
3. Louisiana FastStart (Baton Rouge, LA)
4. Louisiana State Penitentiary (Angola, LA)
5. Trident Technical College (Charleston, SC)

Austria

1. Austrian Building Trades Association (Vienna)
2. Austrian Construction Trades Association (Vienna)
3. Austrian Economic Chambers (WKO) (Vienna)
4. BAUAkademie Oberoesterreich (Steyregg)
5. Chamber of Commerce, Crafts and Trades (Vienna)
6. Part-Time Vocational School for Construction (Vienna)
7. SkillsAustria (Vienna)
8. Swietelsky (Steyregg)

Germany

1. Evonik Chemical Park (Marl)

Switzerland

1. Swiss Association for Small and Medium Sized Enterprises (Winterthur)
2. Swiss Contractor's Association (Winterthur)
3. Swiss Plumber's Association (Winterthur)
4. Swiss Technical College (Winterthur)

The results of the interviews are next summarized for the 45 participants based on the information collected for each question and the two questions driving the interview research.

What barriers of the workforce development system have hindered your own workforce development program?

- The overriding barrier across all interviews was the negative perceptions associated with “touch-labor.” Overcoming the societal perception that success in life requires a college degree prevented meaningful exploration of CTE focused careers. This remained true even when the industries have available positions in well-paying jobs. One result of this barrier is significantly higher average starting age for workers entering the industry which delays career progression. For example, the reported average age for work learning programs across the interview participants was late 20s. This is also indicative of the perception of “touch-labor” being the industry of last resort.
- Funding was reported as a challenge for North American organizations in terms of the flexibility and availability of funding. Funding flexibility was limited due to reporting requirements, stipulations on expense types allowed, and the failure of the funding to be connected to industry needs. Funding availability was limited by the level of funding available and the sustainability of the funding. Figure 15 compares the average annual public funding available per participant in the U.S. registered apprenticeship program, the seven largest U.S. federal workforce development programs based on the most recently available data (Rehabilitation Services Vocational, WIA Dislocated Worker, WIA Youth, TANF, Job Corps, WIA Adult, and Employment Serves), the *public* funding available for the European countries visited, and subsidies for U.S. four-year colleges, excluding loads (College Board 2016). Figure 15 highlights the disparity in U.S. public subsidies for workforce development programs when compared with European apprentice programs and U.S. four-year colleges.

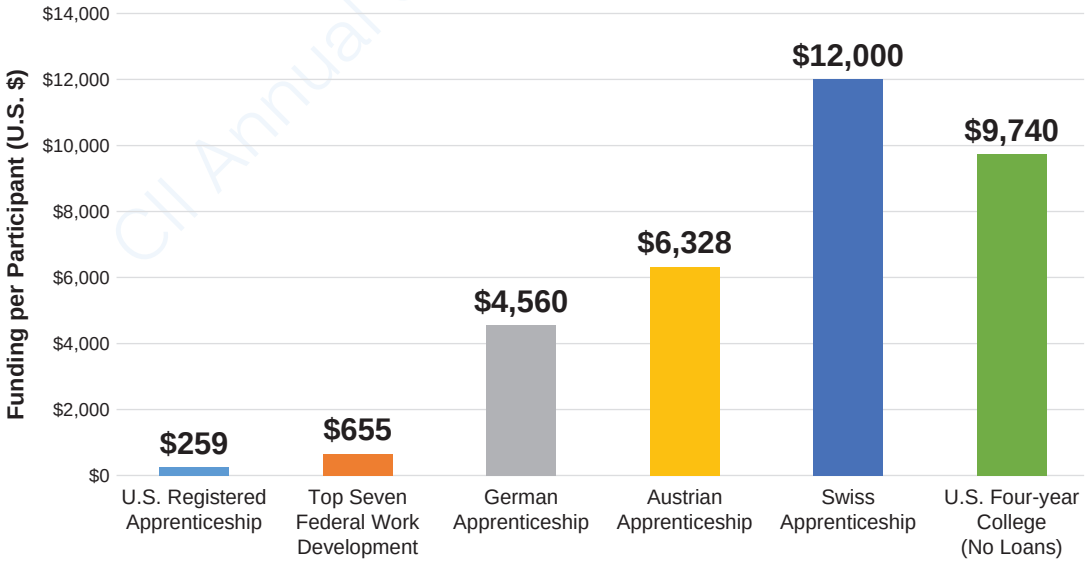


Figure 15. Comparison of Average Annual Participant Costs for Workforce Training Programs

The North American companies and training organizations interviewed reported private expenditures for training programs in the range of $4,000–$5,000 per participant. It should also be noted that, unlike European and Canadian training subsidies, many of the publicly funded U.S. workforce training initiatives are also linked to welfare initiatives, so not all training funds available are utilized for skill development.

- Illicit drug use was identified as a barrier by several North American organizations. This barrier is primarily due to workforce requirements by both public and private owners regarding drug free work environments and criminal histories. The prevalence of drug us in society and these work requirements limits the number available applicant pool for entrants into training programs. This is further compounded by the high numbers of individuals incarcerated for drug offenses which prevents future employment opportunities.

If all barriers were removed, what is one improvement you would make to your workforce development program?

- The most frequented cited potential area for improvement for North American organizations is for earlier involvement of individuals in CTE careers. This could be in the form of pre-apprenticeship programs, CTE exposure and training within primary and secondary schools, and improved work-learning opportunities across educational systems. The interview participants (both North American and European) that have participated in these types of programs reported higher interest and higher retention when individuals are exposed earlier in their educational career.

What aspect(s) of the workforce development system supports your own workforce develop program the most?

- Workforce development programs that contained a strong collaborative element between industry, education, and the governmental stakeholders was the most cited positive element of existing workforce development programs. Successful collaborations focused on a synergistic approach where the strength of each stakeholder were combined to develop workers. Adversarial relationships among the stakeholders reduced the effectiveness of the workforce development systems.

Can you discuss the breakdown of funding for your workforce development program? Is this funding optimal?

- Funding sources for workforce development varied across interview participants. North American private industry workforce development was largely funded internally by the specific company. Some large industries had received state government funding support for training costs to attract industry to the area. European apprentice programs were funded by both private industry and government sources. Several regions had developed unique

funding mechanisms that relied on self-imposed industry fees based on work volume that were then used to fund specific recruitment and training programs for the industry.

- Funding sources were deemed “optimal” when workforce development costs were born across industry stakeholders (e.g., contractors, owners, education, and government) than when they were born by individual entities (e.g., contractors alone) Shared funding was described as optimal for the following reasons:

  1. It increased the overall level of funding available for workforce development.
  2. It ensured that everyone had “skin in the game” in the workforce development process.

Has your organization experienced significant fluctuations in wages and benefits over the past five years?

- Non-union organizations reported significant fluctuations in wages while union organizations reported stable wages

Has your organization found it challenging attracting new professionals into your workforce development program?

- All North American and European industry interview participants reported they were experiencing significant challenges in attracting qualified individuals into their workforce development programs. One organization noted that despite the fact that their workers were in the top 5% of wage earners in their region they still had difficulty in recruiting and retaining employees. One European country noted that their national apprenticeship system had 20% of apprenticeship positions unfilled in 2015.

Do you work with any community-based organizations to help recruit trade professionals?

- All North American interview participants reported they used community-based organizations to recruit individuals into their workforce development system.

Do you work with any community colleges and other outside agencies to provide or deliver your training?

- Several North American and European organizations had established relationships with post-secondary institutions to assist in workforce development initiatives. One North American organization partnered with a local community college for all employee training required over the first three years of employment. One European company had industry funded private construction academies that provides annual continuing education training for skilled crafts as well as apprenticeship training.

Where do you acquire the educational materials for your training efforts?

- Educational materials for interview participant training programs was either developed internally by the organization or industry recognized education materials.

How do you continually develop and provide career progression to your workforce?

- The most commonly cited career progression need across all North American interview participants was the need for clear career paths for individuals entering the industry. This is related to the negative perception of the "touch-labor" careers. The lack of clear career pathways can leave recruits with a sense of limited learning and career advancement opportunities. Several interview participants have developed career pathways for their industries. Some of these pathways were internal to the company while others provided a more broad industry view of career opportunities. Figures 16 and 17 show two broadly focused career pathways for Austria (Figure 16) and Switzerland (Figure 17), which allow craft professionals to progress into other construction professional careers, including project manager and engineers.

Synthesizing the results of the interview effort across all 45 participants offers the following insights into the two central questions to be answered by the case studies.

What are the deficiencies and strengths of the current U.S. workforce development system for the construction industry?

- The biggest deficiency of the current U.S. workforce development system for the construction industry is the negative perception of "touch-labor" by society. In examining the current challenges related to craft professional workforce development (e.g., low levels of CTE funding, focus on four-year college degrees for success, and lack of training opportunities) many of these problems would receive higher attention if U.S. society once again valued the dignity of labor.
- The strength of the current U.S. workforce development system is that society is beginning to realize the need for CTE and regional efforts are underway within companies, local school systems, and state governments to change the workforce development system to prepare students to be productive citizens in their communities.

What sustainable solutions could be identified that address the deficiencies and sustains the strengths? How are these solutions best implemented?

- The interview data was used to develop the policy recommendations and implementation plans described in Section 4.3.

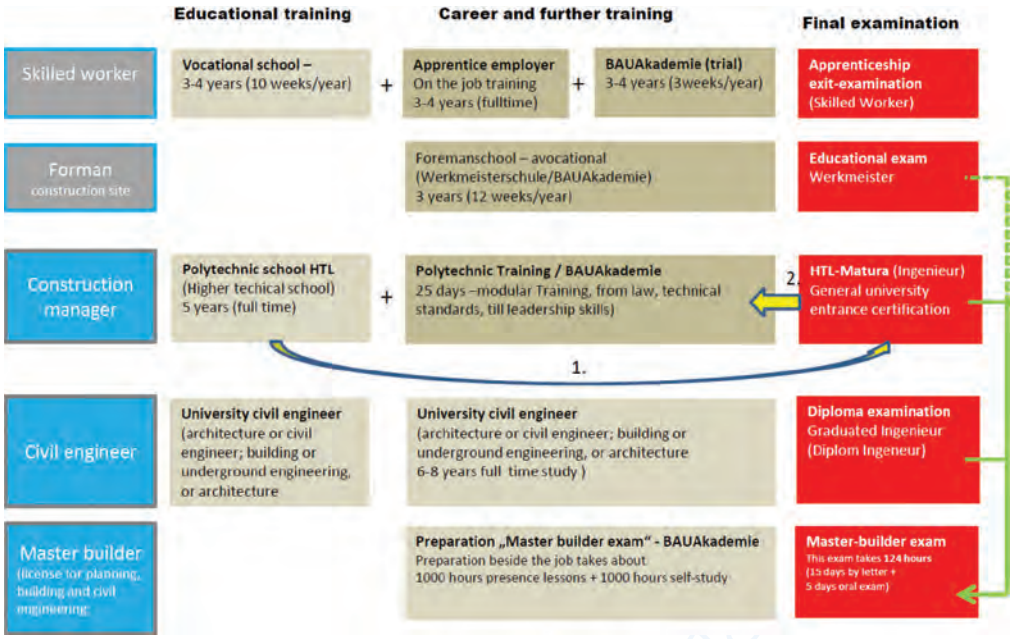


Figure 16. Career Pathway for Austrian Construction Industry
(Courtesy of BAUAkademie)

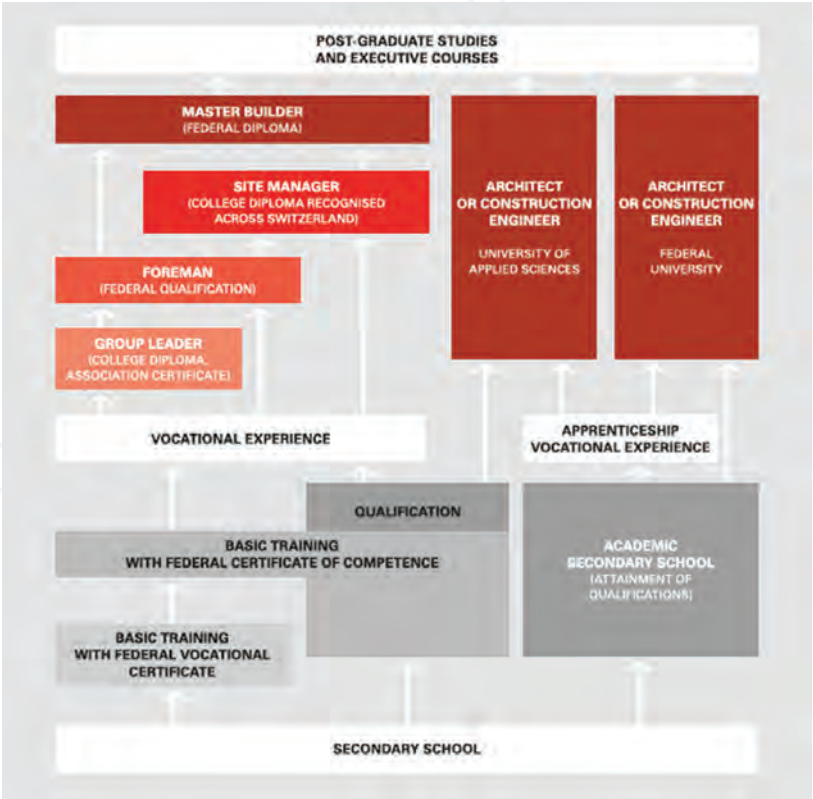


Figure 17. Career Pathway for Swiss Construction Industry
(Courtesy of Swiss Contractors' Association)

4.3. Policy Recommendations and AHP Results

Revitalizing our nation's workforce development system is the path forward toward addressing not only the shortage of construction craft workers but the nation's shortage among numerous technical industries. The effort will require new approaches in how we communicate career opportunities to youth in secondary and post-secondary education, and work-based training among other initiatives. To define this path forward, a series of policies have been developed that impact industry stakeholders and governmental agencies:

Policy 1: Redefine how we measure the quality of our nation's secondary education system by career and college readiness. The nation's secondary education system should be provided greater incentive to ensure the career readiness of all high school graduates.

Policy 2: Establish and strengthen the awareness of career opportunities in our nation. Re-establish the nation's commitment to the equal dignity of all workers by communicating all career-paths to students in secondary education and their parents.

Policy 3: Establish and expand collaboration between industry, education, and government. Promote industry involvement and investment into our nation's secondary and post-secondary Career and Technical Education (CTE) programs.

Policy 4: Develop more balanced funding among post-secondary Career and Technical Education versus University Systems. Increase funding available to CTE programs most needed by industry

Policy 5: Revitalize our work-based learning programs. Significantly improve participation in work-based learning programs by removing barriers to company participation and promoting its exposure in secondary education.

Policy 6: Create a national system that tracks participation and completion of formal craft training, registered apprenticeship, and non-registered apprenticeship programs. A nationwide tracking system enables the government to track the number of people participating in formal craft training, registered apprenticeship, and non-registered apprenticeship programs. The information obtained from this system can be used in performance evaluation, planning, and research.

Policy 7: Measure performance and involvement in workforce development when awarding construction contracts. Assessing construction firms' dedication and commitment to workforce development much like the industry does with safety.

Policy 8: Increase the participation of underrepresented groups in CTE. Increase the recruitment of underrepresented groups in CTE through mentoring and greater outreach.

4.3.1. Policy Recommendations

Policy 1: Redefine how we measure the quality of our nation's secondary education system by career and college readiness.

WHY:

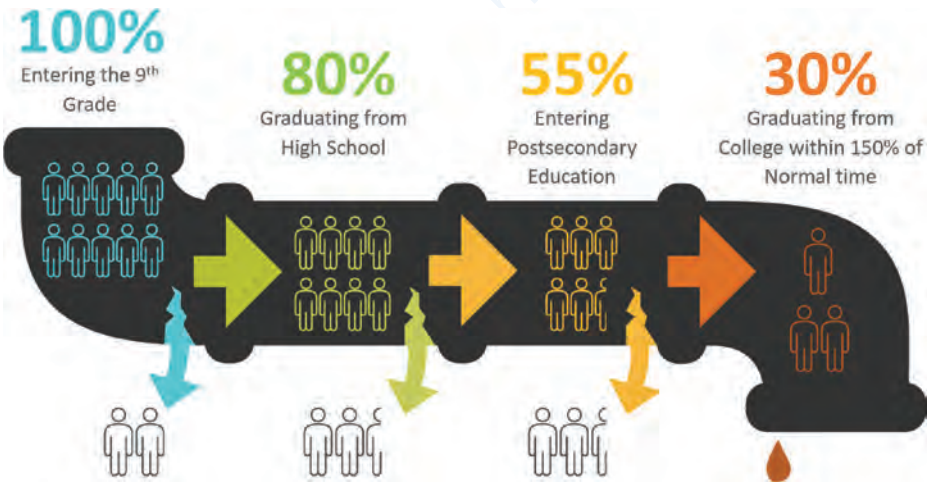
In terms of preparing graduates of our nation's secondary education system, "career readiness" and "college readiness" are currently used interchangeably. Although academic proficiency is essential for any post-high school achievement, career readiness is a broader concept than just preparing individuals for university studies. The goal of career readiness is to prepare *every* student for a successful transition into the workplace as a productive member of society. From a macro perspective, the interconnectedness of the secondary education system with the economy makes career readiness important. Society can be considered a system of interconnected parts or subsystems (e.g., industry, education, government, and community.). In the long run, each part influences and is influenced by other parts to maintain a state of balance for the whole (Parsons 1971). The secondary education system is a subsystem in a dynamic relationship with its social context (Hodge 2007). From this perspective, the appropriateness and fit of the secondary education subsystem are identified primarily by the functions it serves in the whole system (Hodge 2007).

However, several indicators indicate there is misfit between the education system and other subsystems. Studies show a skills gap in the labor market (Symonds et al. 2011, Albattah et al. 2015). A recent survey conducted by Manpower Group (2016) found that construction craft workers, technicians, sales representatives, and machine operators are the hardest jobs for U.S. employers to fill, and they are the types of jobs that CTE training programs are meant to address by providing a qualified workforce. Specifically, about 26,000 construction firms participated in the Associated General Contractors of America's (AGC) survey in 2017 and reported that growing workforce shortages have made it difficult to find qualified workers, and this challenge will continue for the foreseeable future. The U.S. labor market faces a situation in which many young adults lack the skills required to hold many jobs the economy needs (Symonds et al. 2011).

In today's society, it seems there is an implicit assumption that just entering the college can guarantee young adult's success in the labor market and this is the only way to succeed (Gray and Herr 2006). However, data suggests a different story. For every 100 students entering the ninth grade, only 67 will graduate from high school on time; only 38 will enter post-secondary education and training; only 26 will still be enrolled in college during sophomore year; and only 18 will graduate from college with a bachelor's degree within six years, or an associate in three years (Association for Career and Technical Education 2007, Symonds et al. 2011). Despite this enthusiasm

for earning a four-year college degree, not all young adults can successfully finish college. In fact, the college dropout rate in the U.S. is the highest rate among the industrialized countries (Symonds et al. 2011). According to U.S. Department of Education (2017), only 59 percent of those enrolling in a four-year college attain a bachelor's degree after six years. Only about 40 percent of young people attained either an associate's or bachelor's degree by their mid-twenties. This number is even lower for young people of color: 30 percent for African-Americans and 20 percent for Latinos (Symonds et al. 2011). These numbers remind that while attaining a four-year college degree is a viable option for some, it cannot be the only path for success.

One of the main goals of the educations system is to train accountable professionals. Accountability refers to the expectation that professionals should have enough knowledge in their fields and ability to employ that knowledge in practice (Norton et al. 1978). Nevertheless, it seems that the education system does not have any specific plan for young people who neither intend to go to college nor finish it successfully. Some authors referred to these group as the "forgotten half" and argue that the education system prevents them from pursuing an opportunity of meaningful participation in society, because they are not well equipped with required skills and knowledge (Gray and Herr 2006, Symonds et al. 2011).



Sources:

U.S. Department of Education, National Center for Education Statistics. (2017). The Condition of Education 2017 (NCES 2017-144), Public High School Graduation Rates, Retrieved from https://nces.ed.gov/programs/coe/indicator_coi.asp

U.S. Department of Education, National Center for Education Statistics. (2017). The Condition of Education 2017 (2017-144), Immediate College Enrollment Rate, Retrieved from https://nces.ed.gov/programs/coe/indicator_cpa.asp

U.S. Department of Education, National Center for Education Statistics. (2017). The Condition of Education 2017 (NCES 2017-144), Undergraduate Retention and Graduation Rates, Retrieved from https://nces.ed.gov/programs/coe/indicator_ctr.asp

Figure 18. Educational Pipeline

Most high school rating indexes place significant weight on college readiness, which does not meet the need of many high school graduates whose interest in occupations are outside the scope of university studies. There are some instances where the education system encourages schools to put emphasis on both career readiness and college readiness. For example, Every Student Succeeds Act (ESSA 2016) identifies these minimum metrics as indicators of academic progress and school quality:

- Standardized test scores
- High school graduation rates
- Post-secondary enrollment rates for high schools
- School climate (e.g., suspensions, expulsions)
- Educator qualification

However, in most cases our education system places significant emphasis on college readiness (Symonds et al. 2011). High schools exert significant implicit and explicit pressure on students to choose to go college. Some of these pressures are institutionalized in form of: college fairs, campus visitations, financial aids, college-choice workshops for parents, announcing list of graduates, the colleges they are planning to attend, and scholarships they have been awarded, and giving extra value to grades earned in special college prep courses (Gray and Herr 2006). In addition, some argued that the state and federal programs such as No Child Left Behind, renewed the push for high scores on standardized tests (Clark 1997).

It is noteworthy to mention that indicators measured by non-governmental entities, such as the *U.S. News and World Report* and *Newsweek's* high school rankings, also do not consider career readiness (Newsweek 2014, U.S. News 2017). Rather, most high school rating indexes place significant weight on college readiness, which does not meet the needs of many high school graduates whose interests are in occupations outside the scope of university studies. By contrast, the goal of CTE is to provide the academic, technical, and employability skills (such as critical thinking and responsibility) and knowledge graduates need to pursue post-secondary training or higher education and enter a career path (Association for Career and Technical Education, National Association of State Directors of Career Technical Education Consortium, and Partnership for 21st Century Skills 2010). These programs are designed to help individuals attain competencies such as critical thinking, collaboration, problem solving, teamwork, and communication by work and workplace exposure (Brand et al. 2013).

In definition of career readiness, some focus on specific education programs rather than on a progression into employment (Bragg et al. 2007). On the other hand, other definitions consider career readiness in a broader scope by defining it as an individual's

occupational preparation and longer-term solution to employment and skills shortages (Baran et al. 2011).

The definition used in this document is close to the second approach. According to the Association for Career and Technical Education (ACTE) career readiness (Figure 19) is defined as:

- Core academic skills and the ability to apply those skills to concrete situations in order to function in the workplace and in routine daily activities
- Employability skills that are essential in any career area
- Technical, job-specific skills related to a specific career pathway, which may include a broad spectrum of occupations (e.g., medical, law, technical, or computer technician).

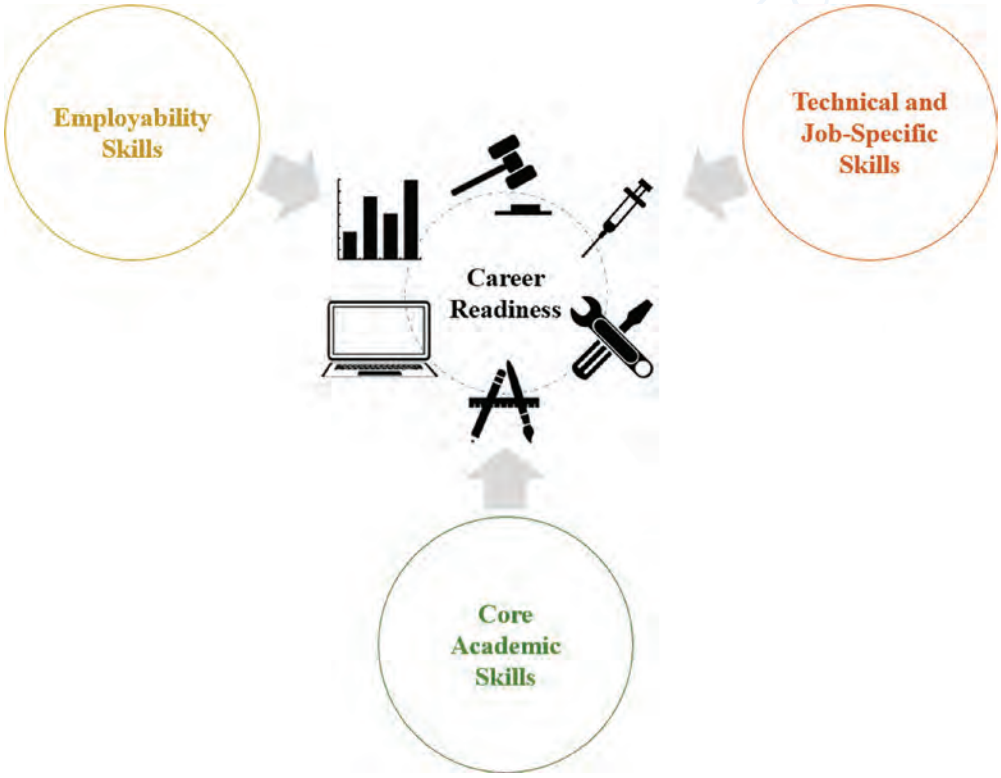


Figure 19. Career Readiness Components

Several studies document the positive effects of CTE on students' test scores, academic grade point averages, and graduation rates (Kulik 1994, Plank et al. 2005, Castellano et al. 2012). U.S. Department of Education data (2014) also indicate average high school graduation rate for students concentrating in CTE is 93% compared to the 80% national average. One possible explanation for these positive impacts is that students who are participating in these programs can see the clear connection

between learning materials and tangible opportunities in the labor market (Symonds et al. 2011). Other research found that the work-based learning environment provided by CTE training programs helps students apply their learning in real settings, increase academic motivation, navigate their career path and develop critical understanding of the work requirements (Alfeld et al. 2007). Although these positive effects are not limitless and there is a threshold for it (Plank et al. 2005).

Since the education system is a key engine of our nation's economic system, one of its main goals is to provide the economy with the inflow of required talents. The over-focus of U.S. society on four-year college degrees over the past several decades, through a noble a well-intended goal, has thrown the interconnected systems of society out of balance and is detrimental both society and the individual By measuring the performance of our secondary education system based on both students' career readiness and college readiness, we can ensure that the needs of all of our nations' high school students are met as well as the needs of our nation's economy.

WHO:

Federal and State government, Department of Education, Department of Labor, business and industry leaders, and community colleges and universities

WHAT:

This policy recommends that the U.S. education system define metrics to measure individual's career readiness in order to evaluate the performance of the nation's secondary education system and to provide greater incentive to ensure the career readiness of all high school graduates. **At a minimum, all high school graduates should be career ready. In addition, all high school graduates be prepared to pursue a variety of post-secondary opportunities including career and technical education, work-based learning, and colleges and universities and primary and secondary school systems should be evaluated on their effectiveness in preparing students for post-secondary opportunities with equal weighting to all post-secondary options.**

Different stakeholders, including the Department of Education, Department of Labor, and business leaders need to join together to define career readiness and associated measures which the performance of secondary education system can be evaluated.

The message communicated to all young people in our primary and secondary education system about their future should be balanced and focused on post-secondary success instead of an emphasis on a single post-secondary opportunity (e.g., university admission). Young people and their parents should be aware of different opportunities and their costs.

Policy 2: Establish and strengthen the awareness of career opportunities in our nation.

WHY:

A poll conducted by the Robert Wood Johnson Foundation and the Harvard T.H. Chan School for Public Health (2015) found that 26% of parents whose children played high school athletics hoped their child would play professional sports. For families with annual household incomes less than $50,000, the number was 39%. Reality is far different. The National Collegiate Athletic Association (2017) estimates that the probability of a male high school athelte participating in the NCAA (across all divisions) in basketball is 3.4% and football is 6.8%. Of these select few, only 1.1% will go on to play professional basketball and 1.5% will go on to play professional football (National Collegiate Athletic Association 2017). Clearly, professional sports is not a suitable career choice for the vast majority of high school students.

Yet, 80% of young people at age 18 or 19 who had just graduated from high school expect to earn bachelor's degree (Gray and Herr 2006). The most important reason they pursue a four-year college degree is that they think this way will result in a high-paying job. As Figure 20 shows, "To improve employment opportunities"; "To make more money"; and "To get a good job" were the top three important factors to attend college, according to participants in the New America Education Policy Program (2015). Despite this goal, only 40% of students entering college will earn a bachelor's degree within six years. And those who do complete the four-year college degree, many with a significant among a personal debt, will discover that only 33% of jobs require a four-year degree. Clearly, the four-year college degree is not a suitable career choice for a significant number of high school students.

Parents are one of the main influencers in the education and career decision-making process (Taylor 2005, Zafar 2011, Granitz et al. 2014). Most parents, teachers, and school counselors consider going to college as the only acceptable career path following high school. More interestingly among students with the least academic ability, the growth in the percentage of parents recommending college experienced the fastest increase (Gray and Herr 2006). On the other hand, there is an image surrounding Career and Technical Education (CTE) programs reflecting that these programs are suitable for low-performing students and cannot prepare students for success in post-secondary education (Brand et al. 2013). However, in reality, studies showed that students who attend CTE programs have better academic grade point averages, higher rates of on-time graduation, and a greater likelihood of successfully finishing a college preparatory mathematics sequence (Plank et al. 2005, Castellano et al. 2012, Neild et al. 2013).

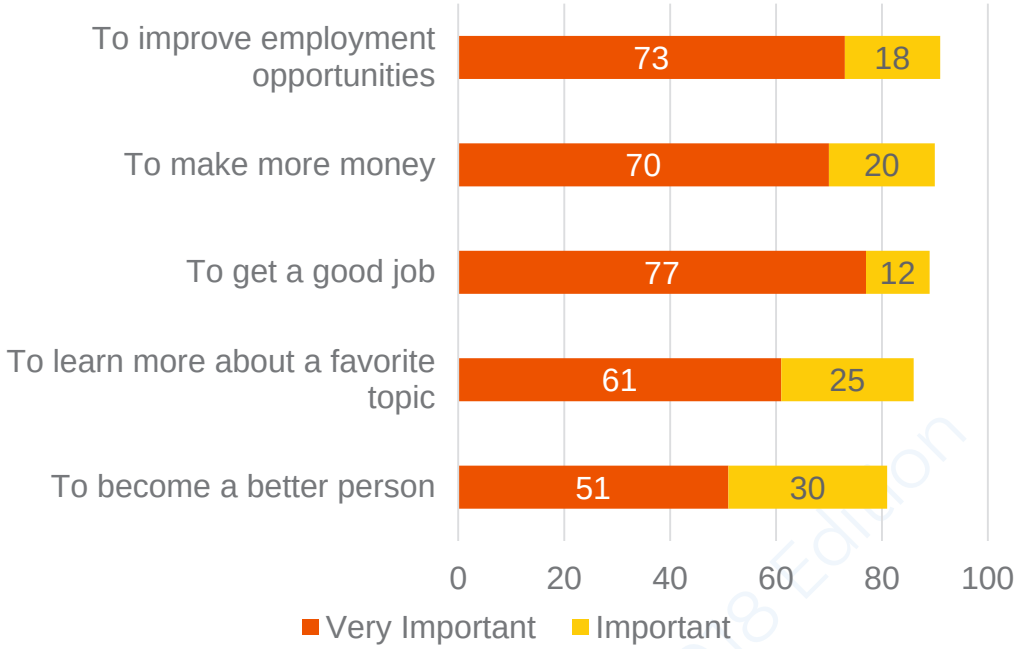


Figure 20. Top Five Reasons in Deciding Go to College According to 2015 College Decisions Survey *(New America Education Policy Program, 2015)*

CTE programs have a positive impact on labor market transitions of young adults. CTE students reportedly are more likely to develop skills such as problem-solving, math, communication, and critical thinking during high school than their non-CTE counterparts (Lekes et al. 2007). These are the skills that most human resource professionals are looking for in today's workforce (Society for Human Resource Management 2014).

Part of the lack of awareness about technical and vocational occupations in society is due to not understanding the labor market as it relates to future supply and demand for CTE occupations. The misconceptions of the future labor market can be described as (Gray and Herr 2006):

1. In the future, most jobs will require four-year degree.
2. All high-wage occupations will require a four-year degree.
3. The total labor force demand for college graduates will be sufficient to provide equivalent employment for all who receive a four-year degree.
4. There will be so many individuals who have a four-year degree that they will take all the good jobs, including those that do not require a baccalaureate degree.

The reality is much different. In any given year, only 33 percent of jobs in the U.S. economy require a bachelor's degree or higher (Carnevale et al. 2010). Furthermore, the supply of four-year degrees significant outpaces the demand. Table 14 provides

the comparison of occupational supply and demand for bachelor's level or above in labor market. From 2015 to 2024, there are on average 955,320 jobs that will need a bachelor's degree each year, meanwhile 1,921,200 people with bachelor's degree will be in the labor market, indicating a 50% underemploymet level in labor market.

Another reason for the lack of information and awareness about technical and vocational occupations is that they are not as well highlighted as majors to students in secondary compared to university degrees and do not have clear career paths for many in society. Most young people start to realize their opportunities in technical occupations after pursuing other career paths and thereby lose precious time to build their career path in other fields like construction. As an indication, only 20% of apprentices are under age of 25 and the average age is about 30 (Lerman and Rauner 2012). In addition, the average age for apprentices in construction trades was reported to be 27 years, which is higher than that that observed in other industrialized countries (Glover and Bilginsoy 2005). It is also significantly higher than 20 years of age, which is the average age of of an undergraduate student at U.S. universities.

Table 14. Comparison of Occupational Supply and Demand by Higher Education Credentials to the Year 2024

	Supply*	Demand**	Under-employment
Bachelor's degrees	1,921,200	955,320	50%
Master's degrees	910,000	89,410	90%
Doctoral or professional degrees	194,900	133,990	31%

* Source: Projection of Education Statistics to 2024 by the National Center for Education Statistics, 2016. Retrieved from https://nces.ed.gov/pubs2016/2016013.pdf

** Source: Occupational Employment Projections to 2024 by the Bureau of Labor Statistics. Retrieved from https://www.bls.gov/emp/ind-occ-matrix/occupation.XLSX

Note: Demand data reflect the average of annual job openings from 2015 to 2024. Supply data reflect the average of annual degrees conferred by degree-granting post-secondary institutions from 2015 to 2024.

Businesses can also help to improve the image of technical occupations by defining career paths within their organization. For example, companies in the construction industry have designed internal programs that allow their employees at the technician level to build their careers in the company and by providing paths to become involved in business at the management levels (McGettingan and O'Neill 2009).

Earlier communication of the options that young people have for their career path along with future predictions of occupational supply and demand and other labor market facts can help the students and their parents make better decisions about their

future. A public awareness campaign marketing efforts can significantly influence the misconceptions mentioned earlier. As a good example, a national marketing campaign in England has dramatically improved society's perception toward apprenticeships and trades in recent years (Olinsky and Ayres 2013).

WHO:

Department of Education, Department of Labor, and business and industry leaders

WHAT:

The message communicated to all young people in the primary and secondary education system about their future should be balanced and focused on post-secondary success instead of an emphasis on university admission. Young people and their parents should be aware of different opportunities and their costs.

Several authors argued that skilled workers have become largely underappreciated in the U.S. society (Schleifer 2002, Gray and Herr 2006). The research team believe that society needs to recognize and reembrace the dignity of work and stop classifying jobs as "Middle Skills" or "Blue Collar." This policy should help re-establish the nation's commitment to the equal dignity of all workers.

The communication should target federal, state and local politicians, business and industry leaders, guidance counselors, teachers, parents and young people with focus on 1) secondary education with continual discussion on post-secondary education; and 2) post-secondary success instead of an emphasis on university admission.

Key areas of communication include:

- Informing young people about the options they have for navigating their chosen career pathways and the related costs
- Clarifying labor market facts and future supply and demand of occupations in the labor market
- Displaying successful people who progressed through different career pathways
- Rebuilding the public image of the nation's career and technical education workforce
- Raising awareness of all high school students in domains such as career path, credentials, apprenticeship programs, and work-based training programs such as NCCER's accredited craft training
- Introducing the ways an individual can get involved in Career and Technical Education (CTE) programs, apprenticeship, and work-based training programs.

Policy 3: Establish and expand collaboration between industry, education, and government.

WHY:

Industry and business leaders directly feel the challenge of recruiting people in non-managerial role with required skills, training, and education (Bridgeland et al. 2011). To promote vocational education in both secondary and post-secondary education levels, the industry needs to take an active role. Since CTE courses often combine classroom-based instruction with work-based learning, internships, or apprenticeships, students will be provided with the opportunity to work with local employers (Brand et al. 2013). On the other hand, industry can carry out several important roles to reinforce vocational education. Businesses and firms can serve as advisors to CTE programs to ensure that curriculum and instruction are relevant, up to date, and reflect changing technologies and knowledge. They can provide information about careers and the skill sets needed to hold certain jobs, mentor students about career opportunities and pathways, donate equipment, provide industry experts as adjunct faculty or volunteer teachers, and offer teachers externships during the summer so that they can learn about new careers, processes, and technologies (Hamilton 2012, Brand et al. 2013).

However, there are obstacles facing government, businesses and educators to cooperate in promoting vocational education. Finding community colleges and/or employers that are willing to develop partnerships or offer work-based placements can be challenging (Brand et al. 2013). Some employers, particularly in small and medium sized firms where the majority of new jobs are being created, neglect to engage in workforce development initiatives (Hamilton 2012).

On the other hand, employers are often frustrated with the speed of government agencies and educational institutions to respond to their immediate needs. To respond to this challenge, states have established regional groups of employers within an industry, who advise workforce and education agencies. Such examples exist in both Alabama and California, which have developed regional workforce development boards to provide an interface between industry and regional school districts and community colleges. (Hamilton 2012 and Made in Alabama 2018). Such industry and governmental collaborations, include European Chambers of Commerce organization in Austria, Germany, and Switzerland, play a significant role in fostering CTE programs in these respected countries and help industry develop work-based training programs. A similar collaboration on a national scale in the U.S. is the National Fund for Workforce Solutions, although it does not have that level of governmental involvement due to it private source of funding.

Another successful example of such collaboration in the U.S. is Louisiana's Jump Start program. The program provides high school students with the opportunities to attain industry-valued credentials in their career paths that lead them to high demanding jobs. At the same time, they are prepared to continue their post-secondary education. This collaboration between school districts, colleges, businesses and workforce development experts help K-12 CTE strategy to be aligned with the state's economic development strategies (Louisiana Department of Education 2015).

Most successful and sustainable vocational training programs have succeeded in establishing partnerships among business, industry, the state, and educators. Therefore, this policy helps to improve the collaborative relationships between government, education system, construction training providers, and industry.

WHO:

Federal and State government, Department of Education, labor unions, and business and industry

WHAT:

The goal of expanding business and industry collaboration are to:

- Identify competencies needed by the industry for the jobs and careers they provide.
- Help to evaluate and identify Career and Technical Education (CTE) curricula and training materials according to industry needs.
- Support and encourage industry workforce development by collaborating with mentors, instructors, and other stakeholders in education system at all levels.
- Promote industry involvement and investment into our nation's secondary and post-secondary Career and Technical Education (CTE) programs.
- Assist industry in navigating governmental regulations as it relates to CTE and work-based training programs.

Policy 4: Develop more balanced funding among post-secondary career and technical education versus university systems.

WHY:

Several data sources show that the overall money received by Career and Technical Education programs across the U.S. has declined over last decade. In fiscal year 2016, Department of Education assigned $1.13 billion or just 1.7 percent of the total $68 billion budget to Career and Technical Education (Department of Education 2016). It is estimated that Federal contribution to CTE is at five percent with state and local dollars supporting teachers' salaries and much of the CTE infrastructure (Dortch 2012). As Figure 21 shows, the nominal Federal budget for Career and Technical Education has declined by 18 percent since 2005, although the overall education budget has increased during this period (U.S. Department of Education 2016). Considering the decrease in value of the U.S. dollar between 2005 and 2016, the actual CTE budget has experienced even greater declines.

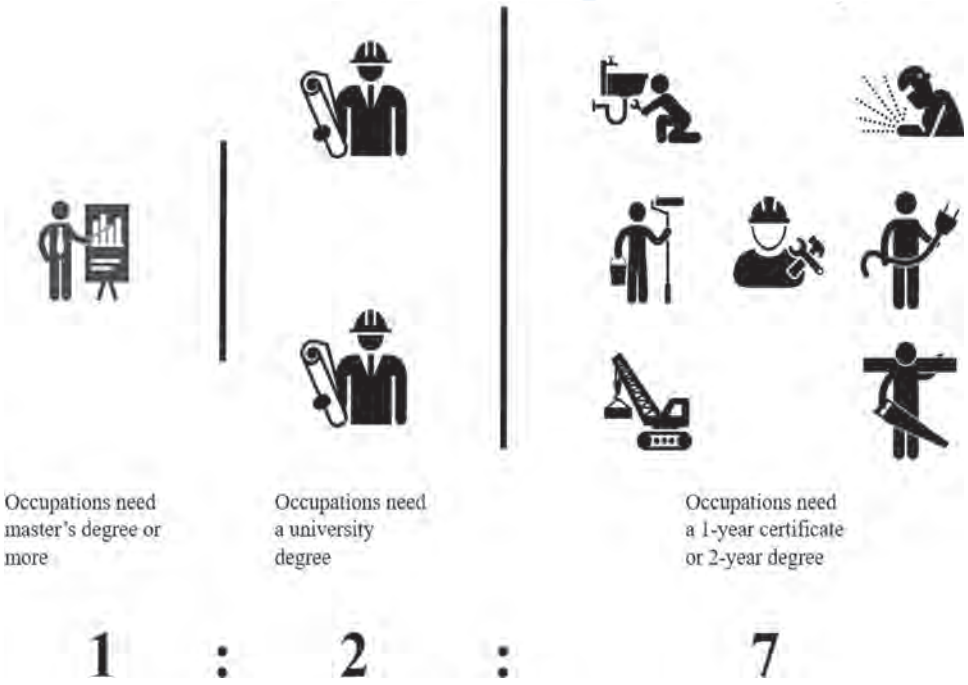
* Numbers adopted from the U.S. Department of Education annual budget summary from 2005 to 2016 available at https://www.ed.gov/

Figure 21. Federal Funding for Career and Technical Education

According to Association for Career and Technical Education (2016), 46% of CTE educators reported that their program budgets have remained stable while almost half of them said their budget have decreased in recent years. Another survey conducted

by National Association of State Directors of Career Technical Education Consortium (2013) indicated that most secondary and post-secondary CTE programs experienced a decline in both Federal and State funding while interest in CTE has increased at the same time.

The U.S. needs to invest more in CTE. CTE programs offer various benefits to students by improving educational attainment and engagement, and providing a clear and meaningful connection between education and career paths (Kulik 1994, Plank et al. 2005, Symonds et al. 2011, Castellano et al. 2012). From a macro perspective, skilled workforce shortages have become critical in several industries, such as construction and manufacturing (Symonds et al. 2011, Albattah et al. 2015). It is vital for the government to understand the value of CTE in providing industries with a greater skilled workforce. As discussed in other policy recommendations and shown in Figure 22, the U.S. industry typically requires 30% of the workforce with a university degree (including a bachelor or graduate degree) and the remaining 70% possess some form of CTE certification (Gray and Herr 2006). As a result, industry need supports the increased funding in CTE education.



* Based on the U.S. labor market data, for every occupation that needs a master's degree or more, two professional jobs require a university degree, and there are seven jobs requiring a one-year certificate or two-year degree. This ratio is a fundamental to all industries (Gray and Herr 2006).

Figure 22. The True Ratios of Jobs in the U.S. Economy

CTE is expensive to implement due to costs associated with lab set-up, equipment and materials purchase. Funding issues also influence recruitment of appropriate instructors. Because they can earn so much more money performing the work, it is always difficult to find knowledgeable and industry-certified instructors for CTE programs at the high school and the techical or community college level.

Improved balanced funding will promote more CTE and internship programs, and encourage greater industry engagement among post-secondary education institutions. Existing public funding sources are often misaligned with business and industry needs and are not well coordinated from program to program and agency to agency. In addition, the industry is often unaware of the types of funding available to support needed workforce development programs or the mechanism to influence the type and direction of program funding.

WHO:

Federal and State governments, Department of Education

WHAT:

The U.S. post-secondary education system includes a broad swath of CTE programs and universities; however, universities receive the clear majority of governmental funding from both state and federal agencies. In addition, a sizable portion of federal workforce budget are allocated to programs that have not tangible impact in creating qualified workers and are misaligned with the needs of business and industry.

The goal of this policy is to increase funding available to CTE programs most needed by industry. To achieve this goal these initiatives are recommended:

- Incorporate work-based training requirements into the federal funding of education programs.
- Re-evaluate how existing funding can be used to support technical training; remove restrictions; allow Title IV to apply to appropriate, industry recognized, accredited technical schools and programs.
- Streamline governmental funding for workforce development by consolidating federal programs and emphasize the use of matches with industry needs to better align the available resources with industry need. Examples of successes with this approach include the following:
  - Canada-Alberta Job Grant Program
  - Workforce Innovation and Opportunity Act (WIOA) solutions
  - State-supported tuition programs for Career and Technical Education (CTE) such as Tennessee College of Applied Technology (TCAT).
- Increase industry or company funding and investment in CTE programs through appropriate governmental tax incentives, internships, and scholarships.

- Establish competitive grants for states seeking to expand their work-based training and apprenticeship programs.
- Ensure incentives exist for individuals to enter into and complete the program (qualifications and employment).
- Raise awareness in both public and private funding organizations to the imminent need to focus attention on high-growth industries, including construction.

Policy 5: Revitalize our work-based learning programs.

WHY:

Work-based learning refers to learning technical, academic, and employability skills, knowledge, and competencies by working in a real work environment (Alfeld et al. 2013). Work-based learning programs can be implemented in different forms. However, they generally have six characteristics in common (Boud and Solomon 2001):

- Formal arrangements are overseen by establishment of partnerships between educational institutions and external organizations.
- Some sort of contractual relationship exists between learners and organizations.
- The programs are designed based on the needs of workplace and learner, rather than being framed by disciplinary or professional curriculum.
- The educational level of the program is established through learners' current competencies and needs, rather than their existing their educational qualifications.
- An important part of learning occurs in the workplace.
- The educational institute assesses the outcomes of the programs with respect to a framework of standards to assure the quality of training.

Three main forms of work-based learning include apprenticeships, internships, and cooperative education (Bailey et al. 2004, Alfeld et al. 2013). The emphasis in apprenticeship programs is on learning by doing. Being the most common form of work-based learning in construction, apprentices are instructed by experienced workers and supervisors at the job site and practice their skills in real work environment (Lerman et al. 2009). Internships are less well-defined and intense form of work-based learning. Usually, students spend time ranging from a few weeks to a full academic year in a position that may be paid or unpaid (Alfeld et al. 2013). The learning connection to school curricula can vary largely (Bailey et al. 2004). Co-operative education is a form of internship but more structured. Co-operative programs are designed to place students in companies during an academic term in either a paid or unpaid as part of a course for credit. The student's learning experience is monitored by a coordinator and/or the teacher of the course (Stern et al., 1995).

Despite many education reformers are arguing that work-based learning should be a much more significant part of the U.S. education system, it has remained a marginal academic strategy (Bailey et al. 2004, Alfeld et al. 2013). Some believe that work-based learning is limited to those who have already completed professional education and need to gain experience in their fields. From this perspective, work-based learning is a mean of transition to work and occurs after people choose their career (Bailey et al. 2004). Work-based learning advocates asserted it is a strategy for exploring career possibilities and gaining the knowledge and skills to prepare young people into mature and responsible members of society; instead of education for occupations, education through occupations is emphasized (Hamilton 1990, Bailey et al. 2004). Furthermore, work-based learning is not only teaching youths a specific trade but also preparing them for adulthood (Hamilton 1990). Work-based learning should be considered as a main strategy in the U.S. education system to engage youths earlier in career training and help develop knowledge and skills needed to prepare them for adulthood.

According to the Department of Labor (2016), approximately 500,000 apprentices were registered with the Bureau of Apprenticeship and Training in 2016. The average age of participants is about 30, and they are often high school graduates (Lerman and Rauner 2012). Since most participants are well beyond high school, the registered apprentice system has not been considered as a component of secondary school education reform (Bailey et al. 2004).

Employers' participation is one of the main elements of work-based learning programs (Boud and Solomon 2001, Bailey et al. 2004). Many European countries, like Germany where work-based learning is common, have a culture of employer participation in workforce development efforts including apprenticeship (Bailey et al. 2004). Bailey et al. (2004) identified three main reasons that motivate employers to enter these programs: philanthropic motivations, individual self-interests and collective benefits. Several researches indicated that employers' commitment to their communities and well-being of their towns and neighborhood is the most important motivation or at least as important as self-interest factors (Lynn and Wills 1994, Pauly et al. 1994, Bailey et al. 2004). Effectively utilizing of work-based learning programs in the construction industry will lead to reduced labor costs, more experienced journeymen, and ultimately long-term sustenance of the industry (Fayek et al 2003).

There are a number of issues preventing significant expansion of work-based training. Olinsky and Ayres (2013) mentioned to the challenges facing registered apprenticeship programs in the U.S. These challenges include limited occupational and gender reach, poor understanding of apprenticeships among American workers and businesses, costs to businesses to involve in the programs, and lack of coordination with the education system. Lewis and Stone (2011) believed that unwillingness of U.S. employers to

invest in apprenticeship programs is due to several factors including the long periods of indenture required by apprenticeships, the difficulties of enforcing contracts, higher wages for work than those for paid apprentices, and the reluctance of employers to train young people who have not made a firm commitment to an occupation or who may take their skills to another employer.

The administrative processes and paperwork required for the U.S. registered apprenticeship programs deter companies and training programs in participations, which results in under reporting and potentially misallocation of governmental resources. While the federal government provides significant aid for college students through subsidized and unsubsidized student loans, there is no automatic and direct assistance for businesses or workers in work-based training programs. In contrast, the government in many other countries significantly subsidize the cost of apprenticeships. In addition, not all states have tax incentives for businesses offering apprenticeships. Other barriers to work-based training programs include time requirements that are rigid, not always business-relevant, and not suitable for individuals to excel and progress. Furthermore, on-the-job training hours are limited by ratios that do not always align to business needs and available work hours on construction jobsites.

To design an effective work-based learning, the needs and wants of adult learners should be understood. Rogers (1996) suggests that the traditional model for teaching children is passive, while adults learn most effectively through active methods. Knowles (1984) proposes that adult learners demonstrate the following characteristics:

- Self-directed and autonomous – need to be facilitated, not taught
- Goal oriented – seek learning consistent with personal goals
- Need for relevance and immediacy – can apply principles to practice
- Practical – can understand reasoning
- Respected by facilitators and treated as mature adults.

It is clear that older learners need to be treated differently than younger learners, and this has implications for work-based learning. One model that can adapt to adult learners is competency-based learning. Competency is the capability to apply or use a set of related knowledge, skills, and abilities to successfully perform work functions in a defined work setting (Competency Model Clearinghouse 2015).

Giving learners greater flexibility in balancing their studies and personal responsibilities, giving learners the opportunity to study on their own pace, enabling pre-assessment of competencies, easier communicating of the competencies needed to master to achieve career goals, accelerating the time to completion of a qualification by

enabling prior learning to be recognized, and entering the workforce based on proven competency are main advantages of competency-based approach toward work-based learning (Ratcliffe 2002, Yasinski 2014).

Schleifer (2002) argued that traditional four-year apprenticeships as a main form of work-based learning may be too long to be attractive in today's labor market, and efforts need to be made to determine the shortest potential length of training necessary using the latest techniques without sacrificing quality. Based on these differences, some researchers used the term "accelerating training" to describe the approach that should be adopted for adults learners. This approach is dependent on a number of factors:

- Participation by highly motivated apprentices dedicated to accelerated progress
- Flexible training schedules accommodating accelerated progression
- Streamlined administrative procedures to facilitate accelerated progression
- Cooperative arrangements between the training provider and learner to ensure the exploitation of training opportunities
- Training plans that create opportunities for the apprentice to gain accelerated access to training
- Off-the-job training in accordance with individual training plans that promote accelerated progression (Sparks et al. 2009)

In addition, there is a difference between employers' and individuals view on required skills. Usually employers tend to have a narrower vision of individual's skill needs, which is more short-term in nature. Therefore, it is necessary to ensure that work-based training programs balances this priority with the long-term need to equip individuals with a broader set of transferable skills. This approach ensures that individuals are equipped with a broad set of foundational skills, which will make them more resilient to potential changes in the labor market (Hamilton 2012). Quality industry, education and government recognized certification programs that allow workers to demonstrate proficiency against appropriate industry defined criteria is a valuable workforce development asset.

Finally, the lack of student and parent demand may be a significant problem for promoting work-based learning programs than other barriers (Bailey et al. 2004). The perception of parents, school administrators, counselors, and politicians toward work-based learning should be changed. Work-based learning should not be considered a lessor alternative comparing to traditional academic learning or failure. Rather, it is an equivalent occupational pathway.

WHO:

Federal and State governments, Department of Education, Department of Labor, state departments of economic opportunity, state department of commerce, and business and industry leaders

WHAT:

To significantly improve work-based learning programs, these initiatives are recommended:

- Streamline the bureaucratic requirements and administrative processes for both companies and training providers in order to encourage them to participate in registered apprenticeship programs by:
  - Improving time to approval
  - Providing consistent guidelines for applications and reporting guidelines across all states
- Recognizing work-based learning models such as the ones provided by the National Center for Construction Education and Research (NCCER)
- Providing Federal and State tax incentives for employers who invest in developing their workers
- Creating more flexible training schedule according to companies' constraints and available positions by encouraging the development of competency-based training
- Allocating Federal and State funding to registered apprenticeship and work-based programs such as NCCER based on the program enrollments and its performance
- Specifically for the construction industry, revising Davis-Bacon legislative requirements in order to include work-based training programs is advised.

Policy 6: Create a national system that tracks participation in and completion of formal craft training, registered apprenticeships, and non-registered apprenticeship programs.

WHY:

No nationwide tracking system identifies individuals who have participated in or completed formal craft training, registered apprenticeships, and non-registered apprenticeship programs. While based on industry survey data, company case studies, and governmental data sources, Wang et al. (2008) found that the majority of construction craft training is informal. There is also evidence that the Department of Labor's Registered Apprenticeship Program underreports the actual number of apprentices in the United States (Lerman 2012). In comparison, most other countries produce more accurate estimates of the number of registered pets (Bradley and King 2012) than the U.S. has access to for the number of certified and qualified construction craft professionals.

Not all businesses in the U.S. are fully aware of the benefits of participating and investing in formal craft training, registered apprenticeship, and non-registered apprenticeship programs. Research in this area using hard data can help establish the credibility and promote all forms of work-based training in the U.S (Olinsky and Ayres 2013). As an example, one research illustrated that Canadian businesses received benefits, on average, of $1.47 for every $1 spent on apprenticeship training (Canadian Apprenticeship Forum 2009). Using the trade-specific data, the study could demonstrate the industry detailed breakdown of the costs and benefits of apprenticeship training as well as the average benefit for each trade.

Our nation's construction craft workforce is a national asset that deserves more careful and accurate monitoring. Lack of accurate and coherent data makes it difficult to measure the performance of the U.S. workforce development system and compare it with the performance of other countries. A better data collection system in the U.S. would help improve the design of work-based training programs and persuade businesses to engage more in this area.

WHO:

Federal and State governments, business and industry

WHAT:

A nationwide tracking system enables the government to track the number of people participating in formal craft training, registered apprenticeship, and non-registered apprenticeship programs. The information obtained from this system can be used in performance evaluation, planning, and research.

Also, it is recommended that Department of Labor involve more detailed job classification in Bureau of Labor Statistics (BLS) database and include questions on job certification or journeyman status in the Current Population Survey.

Policy 7: Measure performance and involvement in workforce development when awarding construction contracts.

WHY:

A skilled workforce is essential to safety, productivity and sustainability of construction and maintenance activities. Studies show that those projects facing skilled workforce shortage experience cost and schedule overruns, and have to deal with increased safety incidents (Karimi et al. 2016, 2017).

As owners recognized the importance of safety, they held their contractors to high standards of safety performance. Owner initiatives in this regard, such as improvement in construction safety and industry adoption of advanced technologies, have resulted in significant industry-wide changes in safety performance.

Similarly, owners have noticed that a qualified workforce is critically important to safety, productivity, on-time, and on-budget completion of construction projects. They also understand that the competence and quality of a contractor's workforce is the direct result of the contractor's commitment to workforce development.

A previous CII research (RT-252 2012) examined the use of the Construction Workforce Development Assessment (CWDA), which was developed by NCCER and CURT in collaboration with ABC, and AGC. The CWDA provides a 0 to 100 rating of a contractor's commitment to workforce development across a range of elements. The intention of the CWDA is to allow workforce development to become a key criterion in both the prequalification and the final selection of contractors, just as contractor safety, quality, and schedule are key selection criteria.

CII RT-252 (2012) found that construction firms that score higher on the CWDA also reported lower recordable incident rates, which is an indication of overall improved construction performance. The study also revealed that the most important workforce development element is the firm's formal policy for or commitment to providing a formal craft skills training program. Interestingly, the contractors, owners, and other training professionals that participated in the study had the same perception toward the relative importance of workforce development elements.

Owners need to require contractors to invest in training and improve the skill sets of their workforce. Moreover, contractors must recognize the necessity and benefits of investing in their employees.

WHO:

Federal and State governments, all users of the construction industry services

WHAT:

This policy provides the government and businesses the incentive to become more engaged in workforce development as part of ensuring the future availability of skilled labor. It is recommended that government and businesses who issue construction contracts need to include construction firms' dedication and commitment to workforce development in much the same way as safety, quality, schedule and cost is considered today. Perhaps by offering high tax incentives to employers whose workforce development programs have been evaluated and rated by a third party, the Federal and State government can encourage construction firms to provide more rigorous workforce development programs. Metrics such as CWDA which allow to effectively evaluate a contractor's workforce development commitment and program quality can be used by third parties to audit construction firms.

Policy 8: Increase the participation of underrepresented groups in CTE.

WHY:

Although under-represented groups such as women, veterans, and ex-offenders represent a huge labor pool, they are not always welcomed into the construction industry (Schleifer 2002). Regarding participation of women craft workers, a study conducted by National Women's Law Center (2012) indicated, the percentage of women in construction trades has remained almost the same from 1983 to 2010. This creates a major contrast between jobs in the construction industry and other industries regarding gender diversification. In fact, the percentage of women in many occupations that used to be more male-dominated have increased during the same time period (i.e., 1983 to 2010). Meanwhile, construction trades pay better than many job opportunities for women, and they could be attracted into the industry if contractors could provide a better work environment. As Schleifer (2002) discussed, increasing female participation in construction craft occupations is one of the quickest solutions available to the industry to reduce its skilled workforce shortage.

Immigrants have always played a significant role in the U.S. labor force (The Center for Construction Research and Training 2010). The construction industry has experienced a dramatic growth in the number of immigrant workers during last decades, vast majority of them coming from Latin American countries (Burnette 2006). It is estimated that immigrants now account for about 23 percent of the construction workforce while 84 percent of them come from Mexico and other Latin American countries

(Siniavskaia 2015). However, most immigrant workers are concentrated in occupations with relatively low wages which do not require high skills and a formal education (Goodrum 2004, Siniavskaia 2015). Immigrant workers have also higher percentage of job-related incidents and fatalities (Dong and Platner 2004, Goodrum and Dai 2005, Hurley and Lebbon 2012). These findings suggest greater demand for investing in immigrant workers in areas such as hiring, education and training, communicating and building trust, improving working conditions and overcoming language and cultural barriers (Goodrum and Dai 2005, Dai and Goodrum 2011, Hurley and Lebbon 2012).

Ex-offenders can also be another source of skilled workers. In spite of having received certification through National Center for Construction Education (NCCER), American Welding Society (AWS), Automotive Service Excellence (ASE), and other entities, many ex-offenders are either unemployed or underemployed (Louisiana Workforce Commission 2013). The construction industry can help and motivate ex-offenders to get employed in the industry and provide better long-term outcomes for these individuals by offering initiatives suggested under this policy.

However, there are a number of obstacles to reaching these specific labor populations:

- Currently, many lack the educational background, fundamental-intermediate technical skills, and industry experience for entry-level employment, and the skill sets required for success.
- Many individuals from underrepresented groups do not understand or are not aware of the industry career opportunities.
- Many lack knowledge on how to tap into the industry for job opportunities.
- Many lack financial resources to attend technical training and may have cultural and language barriers that hinder their ability to learn and grow.

WHO:

Federal and State governments, Department of Education, Department of Labor, Department of Defense, community-based organizations, and business

WHAT:

The goal of this policy is to increase the recruitment of underrepresented groups in CTE through these initiatives:

- Initiate mentoring programs specifically designed for women.
- Work with community and faith-based organizations that are familiar with the immigrant population to conduct outreach, to recruit, to coordinate vocational English as a Second Language (VESL), training, and other job readiness activities, and to convey job requirements and expectations.

- Concentrate on hiring and training veterans.
- Develop and implement a marketing and outreach strategy that specifically targets the underserved areas and populations.
- Establish a pool of resources such as retiring industry personnel to teach, mentor, and tutor others who may require additional academic assistance and attention;
- Attract workers from declining industries whose jobs are being offshored or replaced by technology.
- Utilize ex-offenders with industry sub-contractors with low security level clearance need.
- Establish a program that allows inmates to fulfill their sentences while learning craft skills and participating in a workplace where their training is supplemented with on-the-job experience under the supervision of craft journey-level workers.

4.3.2. AHP Results

The results of group AHP is categorized based on the relative benefits and costs of each policy. To group the policies, we used the rank of policies. As Figure 23 illustrates, the policies have been organized into three groups:

1. **High benefits and low costs or risks** (green area) – policies in this group include improving the communication of career opportunities in our nation, revitalizing our work-based learning programs, and measuring performance and involvement in workforce development when awarding construction contracts. The research team believes that the policies in this group could be implemented in the short-term.
2. **Either relatively high benefits and high costs/risks, or relatively low benefits and low costs or risks** (yellow area) policies in this group redefine how we measure the quality of our nation's secondary education system to focus on both career and college readiness, increasing the participation of underrepresented groups in CTE, increasing coordination between industry, all secondary and post-secondary education programs, and governmental agencies, and developing more balanced funding across post-secondary CTE and university systems. The members of RT-335 believe that these policies will require a longer-term effort to implement.
3. **Relatively low benefits and high costs or risks** – the team considers only one policy to fall in this category: Create a national system that tracks participation and completion of formal craft training, registered apprenticeship, and non-registered apprenticeship programs.

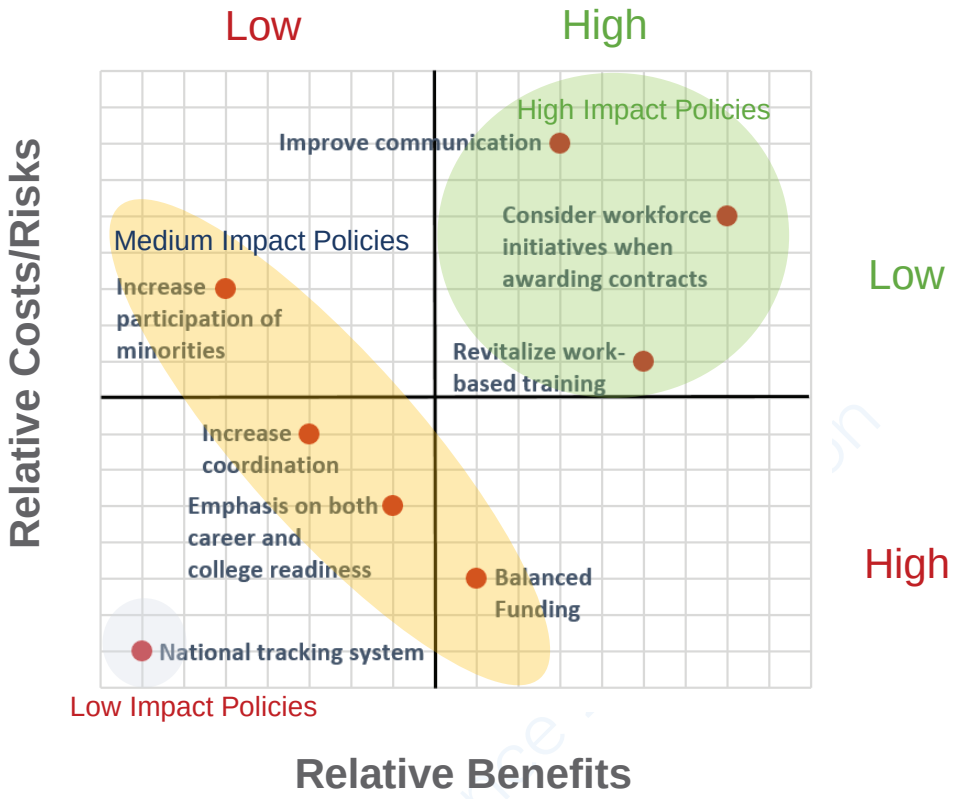


Figure 23. Cost-Benefit Analysis of Policy Recommendations

The results of the AHP Process organized the policies into short-term polices, which could be implemented in three years or less, and policies requiring longer term efforts.

Short-term workforce development policies

- **Establish and strengthen the awareness of career opportunities in our nation**: re-establish the nation's commitment to the equal dignity of all workers by communicating all career-paths to students in secondary education and their parents.
- **Revitalize our work-based learning programs**: significantly improve participation in work-based learning programs by removing barriers to company participation and
- **Measure performance and involvement in workforce development when awarding construction contracts** – assessing construction firms' investment and commitment to workforce development much like the industry does with safety.

Longer-term workforce development policies

- **Redefine how we measure the quality of our nation's secondary education system by career and college readiness**: the nation's secondary education system must be provided greater incentive to ensure the career readiness of all high school graduates.
- **Increase the participation of underrepresented groups in CTE**: increase the recruitment of underrepresented groups in CTE through mentoring and greater outreach.
- **Establish and expand collaboration between industry, education, and government:** promote industry involvement and investment into our nation's secondary and post-secondary Career and Technical Education (CTE) programs.
- **Develop more balanced funding among post-secondary Career and Technical Education versus University Systems**: increase funding available to CTE programs most needed by industry

Chapter 5
Conclusion

When will our nation invest the resources required to rebuild the workforce? Our ability to build and maintain the once greatest infrastructure system has eroded. We are still a world leader in developing technological innovations, but the workforce required to build the build, operate, and maintain the facilities to support the innovations across their lifecycle is absent. The United States' workforce development system is in need of expansion and renewal. As a system, workforce development includes the recruitment, training, placement and retention of individuals in gainful employment opportunities. Over the past three decades, we have seen a construction workforce shortage emerge. The shortage has worsened to the point that it is not only hard to find quality craft workers, but the shortage is impacting projects' schedule, cost, and safety. As a nation, we have a wealth of resource that can be used to reverse these challenges. If we choose to do nothing, the shortage of craft professionals will get worse and likely accelerate in the next decade due to an aging construction workforce.

Revitalizing our nation's workforce development system is the path forward toward addressing not only the shortage of construction craft workers but the nation's shortage among numerous technical industries. The effort will require new approaches in how we communicate career opportunities to youth in secondary and post-secondary education, and work-based training among other initiatives. The efforts described in previous chapter formulated a series of policy recommendation that have been developed that impact industry stakeholders and governmental agencies. Considering the relative benefits and costs with each policy, there are policies we can be implementing in the short term (less than three years), and there are policies that will require long-term sustained efforts. These policies include:

Short-term workforce development policies

Establish and strengthen the awareness of career opportunities in our nation. Most graduating high schoolers expect to earn a bachelor's degree to enhance employment opportunities and make more money, yet most jobs in the U.S. require a career and technical education (CTE) and associated certification. We must establish our nation's commitment to the equality of all workers by recognizing the dignity of their contribution to society.

Revitalize our work-based learning programs. Despite the tremendous benefits associated with work-based learning, it remains a marginal education strategy in the U.S. Our nation needs to significantly improve participation in work-based learning programs by removing barriers to company participation and promoting its exposure in secondary education.

Measure performance and involvement in workforce development when awarding construction contracts. When owners recognized the importance of safety, they held their contractors to high standards of safety performance, which helped with long-term improvements in worker health and safety. Owners need to assess construction firms' dedication and commitment to workforce development much like they consider their devotion to safety.

Longer-term workforce development policies

Redefine how we measure the quality of our nation's secondary education system by career and college readiness. In terms of preparing graduates of our nation's secondary education system, "career readiness" and "college readiness" are currently used interchangeably. Although academic proficiency is essential for any post-high school achievement, career readiness is a broader concept than just preparing individuals for university studies. At a minimum, all high school graduates should be career ready. The nation's secondary education system should be provided greater incentive to ensure the career readiness of all high school graduates.

Increase the participation of groups underrepresented in CTE. The groups that represent the greatest opportunity for new workers in the construction industry include women, minorities, and veterans. To increase the numbers of these groups within the construction industry, we must increase their presence within secondary and post-secondary CTE programs. This policy helps in recruiting these individuals into construction, but the industry must do a better job of retaining these future professionals with improved worksite conditions and other incentives.

Establish and expand collaboration between industry, education, and government. Industry and business leaders directly feel the challenge of recruiting people for non-managerial roles who possess the required skills, training, and education. To promote CTE in both secondary and post-secondary education levels, the industry has to take an active role promoting industry involvement and investment into our nation's secondary and post-secondary CTE programs.

Develop a more balanced funding of post-secondary alternatives: career and technical education as well as university systems. A sizable portion of public education and workforce funding is not effectively allocated to meet the needs of the national economy. The overall governmental funding received by CTE programs across the U.S. has declined over the last decade. As a nation, we must increase funding available to the CTE programs most needed by industry, through direct funding, incentive programs, and streamlined governmental funding programs.

References

Agapiou, A., Price, A.D.F., and McCaffer, R. (1995). “Planning future construction skill requirements: understanding labor resource issues.” *Construction Management and Economics*, 13(2), 149-61.

Ajzen, I. (1991). “The theory of planned behavior.” *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.

Albattah, M. A., Goodrum, P. M., and Taylor, T. R. (2015). “Demographic influences on construction craft shortages in the U.S. and Canada.” International Construction Specialty Conference (ICSC), Vancouver, June 8-10, 2015.

Alfeld, C., Charner, I., Johnson, L., and Watts, E. (2013). *Work-based learning opportunities for high school students.* Louisville, KY: National Research Center for Career and Technical Education.

Alfeld, C., Hansen, D., Aragon, S., and Stone III, J. (2007). “Inside the black box: Exploring the value added by career and technical student organizations to students’ high school experience.” *Career and Technical Education Research*, 31(3), 121-156.

Ashford, K. (2016). “More Parents Taking on Their Kids’ College Debt.” *Forbes Magazine*. December 29, 2016

Associated General Contractors – AGC (2013). “Seventy-Four Percent of Construction Firms Report Having Trouble Finding Qualified Workers.” *The Associated General Contractors of America*, September 4, 2013. Retrieved October 1, 2016, from https://www.agc.org/news/2013/09/04/seventy-four-percent-construction-firms-report-having-trouble-finding-qualified-0

Associated General Contractors – AGC (2014). “Eighty-Three Percent of Construction Firms Report Having Trouble Finding Qualified Workers to Meet Growing Demand for Construction Services.” *The Associated General Contractors of America*, October 22, 2014. Retrieved October 1, 2016, from https://www.agc.org/news/2014/10/22/eighty-three-percent-construction-firms-report-having-trouble-finding-qualified-0

Associated General Contractors – AGC (2015). “Nationwide Survey Finds 86 Percent of Contractors Have Difficulty Filling Key Craft and Salaried Jobs as Demand for Construction Increases.” *The Associated General Contractors of America*, September 9, 2015. Retrieved October 1, 2016, from https://www.agc.org/news/2016/08/31/two-thirds-contractors-have-hard-time-finding-qualified-craft-workers-hire-amid

Associated General Contractors – AGC (2016). “Two-Thirds of Contractors Have a Hard Time Finding Qualified Craft Workers to Hire Amid Growing Construction Demand, National Survey Finds.” *The Associated General Contractors of America*, August 31, 2016. Retrieved October 1, 2016, from https://www.agc.org/news/2016/08/31/two-thirds-contractors-have-hard-time-finding-qualified-craft-workers-hire-amid

Associated General Contractors of America – AGC (2017). “Expecting growth to continue: the 2018 construction hiring and business outlook.” Retrieved January 1, 2018 from https://www.agc.org/sites/default/files/Files/Communications/2018%20Construction%20Hiring%20and%20Business%20Outlook%20Report.pdf

Association for Career and Technical Education (ACTE) (2007). *Issue Brief: CTE's role in secondary-post-secondary transitions*. Retrieved January 1, 2018 from https://www.acteonline.org/uploadedFiles/Assets_and_Documents/Global/files/Publications/Transitions.pdf

Association for Career and Technical Education (ACTE) (2016), *Building pathways to success*. Retrieved January 1, 2018 from https://www.acteonline.org/uploadedFiles/Assets_and_Documents/Global/files/Policy/Funding%20Infographic%202016.pdf

ASTD Career Development Community (2012). "Bridging the skills gap, help wanted, skills lacking: why the mismatch in today's economy?" *The American Society for Training & Development*, 68(2), 251-290

Bailey, T. R., Hughes, K. L., and Moore, D. T. (2004). *Working knowledge: Work-based learning and education reform*. Psychology Press.

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1982). "Self-efficacy mechanism in human agency." *American Psychologist*, 37(2), 122.

Baran, B., Michon, S., Teegarden, S., Giordano, L., and Lodewick, K. (2011). *Implementing the National Fund for Workforce Solutions*. Third Annual National Evaluation Report, National Fund for Workforce Solutions.

Barnow, B. S., Trutko, J. W., and Piatak, J. S. (2013). *Occupational labor shortages: Concepts, causes, consequences, and cures*. Kalamazoo, MI: W. E. Upjohn Institute for Employment Research.

Bennett, R. (2005). "Marketing policies of companies in a cyclical sector: an empirical study of the construction industry in the United Kingdom." *Journal of Business & Industrial Marketing*, 20(3), 118-126.

Boud, D., and Solomon, N. (2001). *Work-based learning: a new higher education?* McGraw-Hill Education (UK).

Bragg, Debra D., C. Bremer, M. Castellano, C. Kirby, A. Mavis, D. Schadd, and J. Sunderman (2007). *A Cross-Case Analysis of Career Pathway Programs that Link Low-skilled Adults to Family-sustaining*. St. Paul, MN: National Research Center for Career and Technical Education.

Bridgeland, Richard., J. Milano, and E. Rosenblum (2011). *Across the Great Divide: Perspectives of CEOs and College Presidents on America's Higher Education and Skills Gap*. Civic Enterprises and Corporate Voices for Working Families.

Brunette, M. J. (2004). "Construction safety research in the United States: Targeting the Hispanic workforce." *Injury Prevention*, *10*(4), 244-248.

Bureau of Economic Analysis – BEA (2015). "News Release." *Bureau of Economic Analysis,* November 5, 2015. Retrieved from http://www.bea.gov/newsreleases/industry/gdpindustry/2015/pdf/gdpind215.pdf

Business Round Table – BRT (1983). "More Construction for the Money." *Construction Industry Cost Effectiveness Project*, Summary Report, The Business Round Table.

Business Round Table – BRT (1997). *Confronting the Skilled Construction Workforce Shortage*. Construction Cost Effectiveness Task Force, Summary Report, The Business Round Table.

Carnevale, A. P., Smith, N., and Strohl, J (2010), *Help Wanted: Projections of Jobs and Education Requirements through 2018*, Georgetown, DC: Center on Education and the Workforce, Georgetown University.

Carnevale, A. P., Smith, N., and Strohl, J. (2013). *Recovery: Job growth and education requirements through 2020*. Georgetown, DC: Center on Education and the Workforce, Georgetown University

Castaneda, J. A., Tucker, R. L., Haas, C. T., and Glover, R. W. (2003). "A revolutionary and structured approach to construction work force management: The tier II strategy." In *Proceedings, 2003 Construction Research Congress.* American Society of Civil Engineers.

Castaneda, J., Tucker, R., and Haas, C. (2005). "Workers' Skills and Receptiveness to Operate Under the Tier II Construction Management Strategy." *Journal of Construction Engineering and Management*, 2005, 131(7), 799-807

Castellano, M., Sundell, K., Overman, L. T., and Aliaga, O. A. (2012). "Do career and technical education programs of study improve student achievement? Preliminary analyses from a rigorous longitudinal study." *International Journal of Educational Reform*, 21(2), 98-118.

Chambers D. E., and, Wedel, K. C. (2005). *Social Policy and Social Programs: A Method for the Practical Public Policy.* Pearson Education.

Chen, L., Pratt, J. A., and Cole, C. B. (2016). "Factors Influencing Students' Major and Career Selection in Systems Development: An Empirical Study." *Journal of Computer Information Systems*, 56(4), 313-320.

Clark, E. (1997). *Designing and implementing and integrated curriculum*. Brandon, VT: Holistic Education Press.

Clinch, M. (2014). "Four reasons the U.S. is recovering . . . and leaving the world behind." *Economy*, CNBC, May 19, 2014.

Cohen, M. (1995). *Labor Shortages as America Approaches the Twenty-first Century*. Ann Arbor, MI: The University of Michigan Press.

Competency Model Clearinghouse (2015). "Competency Models – Communicating Industry's Education and Training Needs Competency Model Development and Use – A Technical Assistance Guide," https://www.careeronestop.org/competencymodel/info_documents/tag.pdf

Construction Industry Institute – CII (2000). *Attracting and Maintaining a Skilled Construction Work Force*. Research Summary 135-1*,* Austin, TX: Construction Industry Institute.

Construction Industry Institute – CII (2015). *Is there a Demographic Craft Labor Cliff that will Affect Project Performance?*, Research Summary 318-1, Austin, TX: Construction Industry Institute.

Construction Industry Institute (CII) (2012). *Construction Productivity Research Program – Phase IV*, Research Summary 252-1c, Version 1.1. Austin, TX: Construction Industry Institute.

Construction Users Roundtable - CURT (2001). "The Skilled Construction Workforce Shortage and the CURT 2001 Workforce Development Survey Results." Cincinnati, OH: Construction Users Roundtable.

Dai, J., and Goodrum, P. M. (2011). “Differences in perspectives regarding labor productivity between Spanish-and English-speaking craft workers.” *Journal of Construction Engineering and Management*, 137(9), 689-697.

Dainty, A., Ison, S., and Root, D. (2004). “Bridging the skills gap: a regionally driven strategy for resolving the construction labor market crisis.” *Engineering, Construction and Architectural Management*. 11(4), 275-283.

Dessler, G. (2013). *Human Resource Management*. Upper Saddle River, NJ: Pearson Prentice Hall.

Dong, X., and Platner, J. W. (2004). “Occupational fatalities of Hispanic construction workers from 1992 to 2000.” *American Journal of Industrial Medicine*, 45(1), 45-54.

Dong, X., Wang, X., and Goldenhar, L. (2016). “Workplace Safety and Health Perceptions of Construction Workers” Center to Protect Worker’s Rights (CPWR) – Data Center, Quarterly Data Report, Third Quarter 2016. Retrieved March 23, 2017, from http://www.cpwr.com/sites/default/files/publications/3rd_Quarter_2016_0.pdf

Dortch, C. (2012, December). Carl D. Perkins career and technical education act of 2006: implementation issues. In *CRS Report for Congress* (Vol. 42858).

Druker, J. and White, G. (1996). *Managing People in Construction*. London: IPD.

Dynarski, S. (2015). “We’re Frighteningly in the Dark about Student Debt.” *New York Times*. March 21, 2015.

Fang, D., Zhao, C., and Zhang, M. (2016). “A Cognitive Model of Construction Workers’ Unsafe Behaviors.” *Journal of Construction Engineering and Management*, 142(9), 04016039.

Fayek, A. R., Shaheen, A., and Oduba, A. (2003). “Results of a pilot study to examine the effective integration of apprentices into the industrial construction sector.” *Canadian Journal of Civil Engineering*, 30(2), 391-405.

FMI (2013). “Skills Shortages in a Booming Market: The Big Oil and Gas Challenge.” September 2013, FMI Corporation, https://www.fminet.com/special-reports/skills-shortages-in-a-booming-market-the-big-oil-and-gas-challenge/.

Foroohar, R. (2017). “The US College Debt is Becoming Dangerous.” *Financial Times*. April 9, 2017.

Fridley, D. (2013). “Construction Last Out of Recession.” Worksource, Oregon Employment Department, <www.qualityinfo.org/olmisj/ArticleReader?itemid=00005457> (May 20th, 2013).

Friedman, Z. (2017). “Student Load Debt in 2017: A $1.3 Trillion Crisis.” *Forbes Magazine*. February 21, 2017.

Fujita, S. (2014). “On the Causes of Declines in the Labor Force Participation Rate.” Federal Reserve Bank of Philadelphia report, February 6, 2014. Retrieved April 9, 2014, from http://philadelphiafed.org/research-and-data/publications/research-rap/2013/on-the-causes-of-declines-in-the-labor-force-participation-rate.pdf

Gelderen, M. V., Brand, M., Praag, M. V., Bodewes, W., Poutsma, E., and Gils, A. V. (2008). Explaining entrepreneurial intentions by means of the theory of planned behavior. *Career Development International*, 13(6), 538-559.

Glavin, M. (2013). “Construction Projection to Be the Fastest Growing Occupation over the Next 10 Years.” *Workforce Under Construction*. Retrieved April 9, 2014, from http://workforceunderconstruction.com/featured/construction-employment-projected-to-be-the-fastest-growing-occupation-over-the-next-10-years/

Glover, R. W., and Bilginsoy, C. (2005). Registered apprenticeship training in the US construction industry. *Education+ Training*, 47(4/5), 337-349.

Gonzales, D. (2013). “Workforce trends in the construction industry.” *Zurich American Insurance Corporation*.

Goodrum, P. M. (2004). “Hispanic and non-Hispanic wage differentials: Implications for United States construction industry.” *Journal of Construction Engineering and Management*, 130(4), 552-559.

Goodrum, P. M., and Dai, J. (2005). “Differences in occupational injuries, illnesses, and fatalities among Hispanic and non-Hispanic construction workers.” *Journal of Construction Engineering and Management*, 131(9), 1021-1028.

Goodrum, P. M., and Gangwar, M. (2004). “The relationship between changes in equipment technology and wages in the US construction industry.” *Construction Management and Economics*, *22*(3), 291-301.

Granitz, N., Chen, S., and Kohli, K. K. (2014). “Choosing business as a college major: A survey of high school students.” *Journal of the Academy of Business Education*, 15(1).

Gray, K. C., and Herr, E. L. (2006). *Other Ways to Win: Creating Alternatives for High School Graduates*. Thousand Oaks, CA: Corwin Press.

Hamilton, S. F. (1990). *Apprenticeship for Adulthood: Preparing Youth for the Future*. New York, NY: Free Press.

Harker, P. T. (1987b). “Incomplete pairwise comparisons in the analytic hierarchy process.” *Mathematical Modelling*, 9, 837–848.

Haskel, J., and Martin, C. (1993). “The Causes of Skill Shortages in Britain.” *Oxford Economic Papers*, 45, 573-588.

Healy, J., Mavromaras, K., and Sloane, P. (2011). “Adjusting to Skill Shortages: Complexity and Consequences.” IZA Discussion Paper 6097. Bonn: Germany: The Institute for the Study of Labor (IZA).

Hodge, S. (2007). “The origins of competency-based training.” *Australian Journal of Adult Learning*, 47(2), 179.

Hodkinson, P., and Sparkes, A. C. (1997). “Careership: a sociological theory of career decision making.” *British Journal of Sociology of Education,* 18(1), 29-44.

Hurley, D. T., and Lebbon, A. R. (2012). “A comparison of nonfatal occupational injuries and illnesses among Hispanic versus non-Hispanic workers in the United States. *Hispanic Journal of Behavioral Sciences*, *34*(3), 474-490.

Ishizaka, A., and Labib, A. (2011). “Review of the main developments in the analytic hierarchy process.” *Expert Systems with Applications*, *38*(11), 14336-14345.

Ishizaka, A., and Lusti, M. (2006). “How to derive priorities in AHP: A comparative study.” *Central European Journal of Operations Research*, 14, 387–400.

Karimi, H., Taylor, T. R., Goodrum, P. M., and Srinivasan, C. (2016). “Quantitative analysis of the impact of craft worker availability on construction project safety performance.” *Construction Innovation*, 16(3).

Karimi, H., Taylor, T., and Goodrum, P. M. (2017). “Analysis of the impact of craft labor availability on North American construction project productivity and schedule performance.” *Construction Management and Economics*, 35(6), 368-380.

Knowles, M. (1984), *Andragogy in Action*. San Francisco, CA: Jossey Bass.

Komarnicki, E. (2012). “Labor and Skills Shortages in Canada: Addressing Current and Future Challenges.” *House of Commons Committees in Canada* – HUMA, (41-1).

Kraft, M. E., and Furlong, S. R. (2012). *Public policy: Politics, analysis, and alternatives*. Sage.

Kulik, J. A. (1994). “Curricular tracks and high school vocational education.” *Document Resume*, 64.

Lee, I. A., and Preacher, K. J. (2013, September). Calculation for the test of the difference between two dependent correlations with one variable in common [Computer software]. Available from http://quantpsy.org.

Lekes, N., Bragg, D., Loeb, J. W., Oleksiw, C. A., Marszalek, J., Brooks-LaRaviere, M., Zhu, R., Kremidas, C. C., Akukwe, G., Lee, H., and Hood, L. K. (2007). *Career and Technical Education Pathway Programs, Academic Performance, and the Transition to College and Career*. National Research Center for Career and Technical Education.

Lerman, R. I. (2012). “Can the United States expand apprenticeship? Lessons from experience.” IZA Discussion Paper 46. Bonn: Germany: The Institute for the Study of Labor (IZA).

Lerman, R. I., and Rauner, F. (2012). Apprenticeship in the United States. In *Work and Education in America* (pp. 175-193). Springer Netherlands.

Lerman, R., Eyster, L., and Chambers, K. (2009). *The Benefits and Challenges of Registered Apprenticeship: The Sponsors’ Perspective*. Urban Institute (NJ1).

Levernier, W. and Yang, B. (2011). “A Note on the Categories of Unemployment in Principles of Macroeconomics Course.” *Perspectives on Economic Education Research.* 7(1) 58–73.

Li, A., Peng, Q., Zhang, L., and Huang, J. (2009). “The Determinant of Pedestrian’s Unsafe Behaviors in Urban Traffic System—An Empirical Analysis Based on the Theory of Planned Behavior (TPB).” In *International Conference on Transportation Engineering 2009* (pp. 4122-4127).

Louisiana Department of Education (2015), *Louisiana’s Jump Start Program*, Last Retrieved January 1, 2018 from https://www.louisianabelieves.com/docs/default-source/jumpstart/louisiana’s-jump-start-program.pdf?sfvrsn=5

Lynn, I., and Wills, J. (1994). *School Lessons, Work Lessons. Recruiting and Sustaining Employer Involvement in School-to-Work Programs*. Washington, DC: Institute for Educational Leadership.

Ma, J., Pender, M., and Welch, M. (2016). “Education Pays 2016: The Benefits of Higher Education for Individuals and Society.” Trends in Higher Education Series. College Board.

Made in Alabama (2018), *Regional Workforce Councils*, Last Retrieved January 1, 2018 from http://www.madeinalabama.com/workforce-and-training/regional-workforce-councils/

Makhene, D. and Thwala, WD. (2009). “Skilled labor shortages in construction contractors: a literature review.” CIDB paper 25, Construction Industry Development Board.

Manpower Group (2016). *Talent shortage survey results*, Retrieved January 1, 2018 from http://www.manpowergroup.com/wps/wcm/connect/8ccb11cb-1ad4-4634-84ea-1656ee74b3ed/GlobalTalentShortageSurvey-PressRelease.pdf?MOD=AJPERES&ContentCache=NONE&

Marshall, B. (2013). “The Unemployment Rate for the Candidates You Want Is Zero.” *The FordyceLetter webpage*, Retrieved from http://www.fordyceletter.com/2013/05/06/the-unemployment-rate-for-the-candidates-you-want-is-zero/

Martin, P., and Ruhs, M. (2011). “Labor Shortages and US Immigration Reform: Promises and Perils of an Independent Commission.” *International Migration Review*, 45(1), 174-187.

McGettingan, E., and O’Neill, D. (2009). From apprentice to construction manager and beyond: developing a talent pipeline. *Education+ Training*, *51*(3), 220-231.

Mu E., and Pereyra-Rojas M. (2017) *Practical Decision Making.* Springer Briefs in Operations Research. Springer, Cham.

National Association of State Directors of Career Technical Education Consortium (2013). *A Look Inside: A Synopsis of CTE Trends: Funding*, Retrieved January 1, 2018 from https://careertech.org/sites/default/files/SynopsisofCTETrends-Funding-2012.pdf

National Collegiate Athletic Association (NCAA) (2017). *Estimated probability of competing in college athletics*, Retrieved January 1, 2018 from http://www.ncaa.org/about/resources/research/estimated-probability-competing-college-athletics

National Women’s Law Center. (2012). *Women in construction: 6.9 percent is not enough*. Retrieved August 10, 2017, from http://www.nwlc.org/sites/default/files/pdfs/womeninconstructionfactsheet.pdf

Neild, R. C., Boccanfuso, C., and Byrnes, V. (2013). *The academic impacts of career and technical schools: A case study of a large urban school district*. Center for Social Organization of Schools, Everyone Graduates Center. John Hopkins University.

New America Education Policy Program (2015). *College decisions survey*, https://www.newamerica.org/education-policy/edcentral/collegedecisions3/

Newsweek (2014). *Frequently asked questions about Newsweek’s high school rankings*, http://www.newsweek.com/frequently-asked-questions-about-newsweeks-high-school-rankings-268771

Norton, R.E., Harrington, L.G. and Gill, J. (1978). *Performance-based teacher education: the state of the art.* Athens, GA: American Association for Vocational Instructional Materials.

Olinsky, B., and Ayres, S. (2013). *Training for success: A policy to expand apprenticeships in the United States* (pp. 9-15). Washington, DC: Center for American Progress.

Olsen, D., Tatum, M. and Defnall, C. (2012). “How industrial contractors are handling skilled labor shortages in the United States.” *48th ASC Annual International Conference Proceedings,* Associated Schools of Construction, 2012.

Parsons, T. (1971). *The system of modern societies*. Englewood Cliffs, N.J., Prentice Hall.

Passmore, D. L. (2000). *Identifying and responding to skills shortages*. State College, PA: Penn State University.

Pauly, E., Kopp, H., and Haimson, J. (1994). *Home-Grown Lessons: Innovative Programs Linking Work and High School.* School-to-Work Transition Project. New York, NY: Manpower Demonstration Research Corporation.

Plank, S. B., DeLuca, S., and Estacion, A. (2008). "High school dropout and the role of career and technical education: A survival analysis of surviving high school." *Sociology of Education*, 81(4), 345-370.

Ratcliffe, A. E. (2002). *Participants' perceptions of the effectiveness of a competency-based apprenticeship program* (Doctoral dissertation). University of Leicester.

Robert Wood Johnson Foundation and the Harvard T.H. Chan School for Public Health (2015). *Sports and Health in America*, Last Retrieved January 1, 2018 from https://media.npr.org/documents/2015/june/sportsandhealthpoll.pdf

Rogers, A. (1996), *Teaching Adults*, 2nd ed., Buckingham : Open University Press.

Rogers, J. and Baum, R. (2017). "This Economic Bubble is Going to Wreak Havoc When it Bursts." *Fortune*, July 10, 2017

Roy, R., Henson, H., and Lavoie, C. (1996). "A Primer on Skill Shortages in Canada," R-96-8E. Hull, Canada: Human Resources Development Canada.

Saaty, T. L. (1980). *The Analytic Hierarchy Process*. New York: McGraw Hill.

Saaty, T. L. (1990). "How to make a decision: the analytic decision process." *European Journal of Operational Research* 48, 9–26.

Saaty, T. L. (1994). "How to make a decision: the analytic hierarchy process." *Interfaces*, 24(6), 19-43.

Saaty, T. L., and Peniwati, K. (2013). *Group decision making: drawing out and reconciling differences*. Pittsburgh, PA: RWS Publications.

Saaty, T. L., and Vargas, L. G. (2005). "The possibility of group welfare functions." *International Journal of Information Technology and Decision Making*, 4, 167–176.

Saffold, F. (2005). "Increasing self-efficacy through mentoring." *Academic Exchange Quarterly,* 9(4), 13-16.

Sawyer, T. and Rubin, D. (2007). "Leaders Probe New Solutions for Industry's Labor Shortfall." *Engineering NewsRecord*. June 13, 2007. p. 15.

Schoen, J. (2014). "US economic recovery finally taking hold." US Economy, CNBC, December 25th 2014.

Shah, C. and Burke, G. (2005). "Skills Shortages: Concepts, Measurement and Policy Responses." *Australian Bulletin of Labour*, 31 (1), 44-71.

Shelar, S. (2013). "141 Ideas for Solving the Construction Industry's Labor Shortage." *Construction Citizen*. Retrieved April 9, 2014, from http://constructioncitizen.com/blog/141-ideas-solving-construction-industrys-labor-shortage/1312271?goback=%2Egde_4972139_member_582351080396948685 0#%21

Siniavskaia, N. (2015). *Immigrant workers in the construction labor force*. National Association of Home Builders (NAHB), Last Retrieved January 1, 2018 from https://www.nahbclassic.org/fileUpload_details.aspx?contentTypeID=3&contentID=241345&subContentID=637756

Society for Human Resource Management (2014). *Workforce readiness and skills shortages*, Retrieved January 1, 2018 from https://www.shrm.org/hr-today/trends-and-forecasting/labor-market-and-economic-data/Documents/Workforce%20Readiness%20and%20Skills%20Shortages.pdf

Sparks, A., Ingram, H., and Phillips, S. (2009). "Advanced entry adult apprenticeship training scheme: a case study." *Education + Training*, 51(3), 190-202.

Steiger, J. H. (1980). "Tests for comparing elements of a correlation matrix." *Psychological Bulletin*, 87(2), 245-251.

Stern, D. (1995). *School to work: Research on programs in the United States* (Vol. 17). Psychology Press.

Symonds, W. C., Schwartz, R., and Ferguson, R. F. (2011). *Pathways to prosperity: Meeting the challenge of preparing young Americans for the 21st century*.

Taylor, A. (2005). "It's for the rest of your life: The pragmatics of youth career decision making." *Youth & Society*, 36(4), 471-503.

The Center for Construction Research and Training (2010).*Immigrant workers in U.S. Construction: Sharing lessons learned in our unions*. Last Retrieved January 1, 2018 from https://www.cpwr.com/sites/default/files/immigrant_workers_in_construction_cpwr-lohp_report.pdf

The U.S. Department of Labor (2016). *Data and Statistics, Registered Apprenticeship National Results Fiscal Year (FY) 2016*, Retrieved January 1, 2018 from https://doleta.gov/oa/data_statistics.cfm

U.S. Bureau of Labor Statistics – BLS (2014). "How the Government Measures Unemployment." U.S. Bureau of Labor Statistics (BLS), Current Population Survey (CPS), Technical Documentation, June 2014.

U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990, 2000, 2005, and 2009 *High School Transcript Studies* (HSTS)

U.S. Department of Education (2014). *Building a Grad Nation: Progress and Challenge in Ending the High School Dropout Epidemic: Annual Update*.

U.S. Department of Education (2016), *Fiscal Year 2016 Budget Summary and Background Information*, Retrieved January 1, 2018 from https://www2.ed.gov/about/overview/budget/budget16/summary/16summary.pdf

U.S. Department of Education (2017), *The Condition of Education 2017.* U.S. Department of Education, National Center for Education Statistics (NCES 2017-144), Retrieved January 1, 2018 from https://nces.ed.gov/programs/coe/indicator_ctr.asp

U.S. News (2017). "How U.S. News calculated the 2017 best high schools rankings?" https://www.usnews.com/education/best-high-schools/articles/how-us-news-calculated-the-rankings

United States Green Building Council – USGBC (2013). "Smart Market Report: Construction Industry Workforce Shortages – Role of Certification, Training, and Green Jobs in Filling the Gaps." Retrieved May 9, 2013, from www.usgbc.org.

Uwakweh, B. O. (2006). “Motivational climate of construction apprentice.” *Journal of Construction Engineering and Management*, 132(5), 525-532.

Veneri, C. (1999). “Can occupational labor shortages be identified using available data?” *Occupational Shortages, Monthly Labor Review*, March 1999

Vereen, S.C. (2013). “Forecasting Skilled Labor Demand in the US Construction Industry.” A dissertation submitted to the Graduate Faculty of North Carolina State University.

Wang, Y., Goodrum, P., Haas, C., Glover, R., and Vazari, S. (2010). “The Benefits and Cost of Craft Training.” *Journal of Construction Management and Economics*. 28(12), 1269-1285.

Watson, M. (2007). “Concerns for skills Shortages in the 21st century: A review into the construction industry, Australia.” *The Australian Journal of Construction Economics and Building*, 7(1), 45–54.

Wilder, R. (2013). “Big Increase in Gulf Coast Projects Equals Big Demand for Skilled Workers.” *The Conrnerstone*. Retrieved April 9, 2014, from http://www.nccercornerstone.org/features/item/115-big-increase-in-gulf-coast-projects-equals-big-demand-for-skilled-workers

Yasinski, L. (2014). “A Competency-Based Technical Training Model that Embraces Learning Flexibility and Rewards Competency.” *American Journal of Business Education* (Online), 7(3), 171.

Yin, R. (2003). *Case Study Research: Design and Methods*. Applied Social Research Methods Series, Volume 5. Thousand Oaks, CA: Sage Publications.

Zafar, B. (2011). “How do college students form expectations?” *Journal of Labor Economics*, 29(2), 301-348.

Zellweger, T., Sieger, P. and Halter, F. (2011). “Should I stay or should I go? Career choice intentions of students with family business background.” *Journal of Business Venturing*, 26(5), 521-536.

Zhao, S., Li, L., Dong, Z., and Wu, B. (2011). “Analyzing Public Transportation Use Behavior Based on the Theory of Planned Behavior: To What Extent Does Attitude Explain the Behavior?” In the *Proceedings of the 11th International Conference of Chinese Transportation Professionals*, held in Nanjing, China, August 14-17, 2011: Towards Sustainable Transportation Systems (pp. 425-435).

Zhu, L., Zhang, Z., and Bao, Z. (2011). “Speeding Behaviors in Beijing Based on the Theory of Planned Behavior.” In the *Proceedings of the Third International Conference on Transportation Engineering*, held in Chengdu, China, July 23-25, 2011 (pp. 547-554).

Notes

Research Team 335, Improving the Workforce Development System

Eddie Clayton, Southern Company
* Paul Goodrum, University of Colorado Boulder
Indiana Greene, Hargrove Engineers and Constructors
Steve Greene, NCCER
Daniel Grove, CURT
Dean Hamrick, Fluor Corporation
* Farzad Minooei, University of Colorado Boulder
Steve Reinoehl, Zurich
Jennifer Sulak-Brown, Barton Malow
Michael Stilley, S&B
Jon Tate, Zurich
* Tim Taylor, University of Kentucky
Don Whyte, NCCER
Lee Worley, Ironworkers/IMPACT
Boyd Worsham, Haskell

Past Members

Jim Hanna, Fluor
Randy Walker, S&B
Robert Woods, Southern Company
* Hossein Karimi, University of Kentucky

* Principal authors

Editor: Michael E. Burns

Construction Industry Institute
The University of Texas at Austin
3925 W. Braker Lane (R4500)
Austin, Texas 78759-5316

FR-335

Changing How
the World Builds