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Interdisciplinary studies for the success of disadvantaged business enterprises in the transportation sector

by

Hongtao Dang

A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Civil Engineering (Construction Engineering and Management)

Program of Study Committee:
Jennifer S Shane, Major Professor
Beth L Hartmann
Benjamin Ahn
Ulrike Genschel
Cristina Poleacovschi

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this dissertation. The Graduate College will ensure this dissertation is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University

Ames, Iowa

2019

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STATE ABBREVIATIONS

Alabama	AL	Montana	MT
Alaska	AK	Nebraska	NE
Arizona	AZ	Nevada	NV
Arkansas	AR	New Hampshire	NH
California	CA	New Jersey	NJ
Colorado	CO	New Mexico	NM
Connecticut	CT	New York	NY
Delaware	DE	North Carolina	NC
Florida	FL	North Dakota	ND
Georgia	GA	Ohio	OH
Hawaii	HI	Oklahoma	OK
Idaho	ID	Oregon	OR
Illinois	IL	Pennsylvania	PA
Indiana	IN	Rhode Island	RI
Iowa	IA	South Carolina	SC
Kansas	KS	South Dakota	SD
Kentucky	KY	Tennessee	TN
Louisiana	LA	Texas	TX
Maine	ME	Utah	UT
Maryland	MD	Vermont	VT
Massachusetts	MA	Virginia	VA
Michigan	MI	Washington	WA
Minnesota	MN	West Virginia	WV
Mississippi	MS	Wisconsin	WI
Missouri	MO	Wyoming	WY
District of Columbia	DC		

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NOMENCLATURE

AAIA	Airport and Airway Improvement Act
AGC	Associated General Contractors
ANC	Alaska Native Corporation
ASCE	American Society of Civil Engineers
BC	Business Challenge
BDP	Business Development Plan
BECO	Business, Engineering, Construction, and Other
CACAO	Certification, Administration, Compliance, Analytics, and Outreach
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CFR	Code of Federal Regulation
CUF	Commercially Useful Function
DBE	Disadvantaged Business Enterprise
DBELO	Disadvantaged Business Enterprise Liaison Officer
DOC	Department of Commerce
DOT	Department of Transportation
EBO	Equal Business Opportunity
EEO	Equal Employment Opportunity
FAA	Federal Aviation Administration
FAST-ACT	Fixing America's Surface Transportation Act
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GAO	Government Accountability Office (former General Accounting Office)
ISTEA	Intermodal Surface Transportation Efficiency Act
IT	Information Technology
LEED	Leadership in Energy and Environmental Design
MAP-21	Moving Ahead for Progress in the 21st Century Act
MBDA	Minority Business Development Agency

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MBE	Minority Business Enterprise
MPP	Mentor-Protégé Program
NAICS	North American Industry Classification System
NAMC	National Association of Minority Contractors
NBE	Non-disadvantaged Business Enterprise
NCHRP	National Cooperative Highway Research Program
NMSDC	National Minority Supplier Development Council
NPRM	Notice of Proposed Rulemaking
OCR	Office of Civil Rights
OGC	Office of General Counsel
OJT	On-the-Job Training
OIG	Office of Inspector General
OMBE	Office of Minority Business Enterprise
OS	Overall Statement
OSDBU	Office of Small and Disadvantaged Business Utilization
PCA	Principal Component Analysis
PNW	Personal Net Worth
RAW	Ready, Willing, and Able
RMSEA	Root-Mean-Square Error of Approximation
SAFETEA-LE	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SBA	Small Business Administration
SBE	Small Business Enterprise
SNPRM	Supplemental Notice of Proposed Rulemaking
SRMR	Standardized Root Mean Square Residual
STA	State Transportation Agency
STAA	Surface Transportation Assistance Act
STURAA	Surface Transportation and Uniform Relocation Assistant Act
TEA	Transportation Equity Act
TLI	Trucker-Lewis Index

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TRB	Transportation Research Board
UCP	Unified Certification Program
US	United States
USC (or U.S.C.)	United States Code
WBE	Women Business Enterprise

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I thank Drs. Jennifer Shane and Beth Hartmann for their advice, motivation, patience, and inspiration. I would not have completed the doctoral work without their constant support, thought-provoking critiques, rigorous reviews, and enlightening guidance. I am grateful to spend several years of my life learning from the best and becoming an independent and responsible researcher who begins and continues contributing to the body of knowledge. I also want to thank Drs. Benjamin Ahn, Ulrike Genschel, and Cristina Poleacovschi for their support and advice as committee members.

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If I were a tree, the family would be my roots and soils. Family supports me grow, mature, develop, and sometimes leap into advanced levels and new space. I am so lucky to have and deeply loved by parents who are willing to support me studying abroad. I appreciate my elder sister, who has taken excellent care of my parents when I am far away from them. As the family is important to me, I am joyful to meet Dr. Bing Liu at Iowa State University. We got engaged when I passed my preliminary exam. We got married when I passed my final oral defense. Dr. Liu has been there with me and has supported me for every progress I have made on my doctoral work.

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If I were a tree, friends, mentors, advisors would be my air and sunshine. Only with them, I can grow strong and flourish to prosperity. I thank all of them from both Iowa State University and Central Washington University. Particularly, I am grateful for the opportunities provided by the Trinect program mentored by Drs. Joanne Olson, Adah Leshem, and Raj Raman. The program has provided me an opportunity to teach science and engineering in elementary schools and broadened my understanding of pedagogy and education. I appreciate the Preparing Future Faculty program led by Dr. Holly Bender and Ms. Karen Bovenmyer. The program is both informative and transformative to graduate students and young faculty. Besides my advisor and committee members, I have benefited from many mentors, including Drs. Terry Wipf, Charles Jahren, Michael Perez, Matt Rouse, and Jiehua Shen. Their kind words and warm conversations have shaped me to be an excellent faculty member at Central Washington University. I acknowledge the support from Drs. Paul Ballard, Sathyanarayanan (Sathy) Rajendran, Warren Plugge, and David Martin from Central Washington University. Last but not least, I thank Dr. In-ho Cho for working with me on multidiscipline applications of advanced structure mechanics and computation methods and developing manuals for virtual earthquake engineering laboratory.

If I were a tree, pursuing a Ph.D. degree would be constructing a creek with overflowing water in my vicinity. I learned much that I did not know, and knowing there would be so much more to experience and challenge. More importantly, I learned how to learn, research, and write and committed to being a lifetime learner.

Finally, I thank the Iowa Department of Transportation for collaborating with the Institute for Transportation on providing supportive services to DBEs. The collaboration work exposed me to the DBE community and inspired me to conduct this doctoral research.

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ABSTRACT

The United States Department of Transportation established the Disadvantaged Business Enterprise (DBE) program to ensure nondiscrimination and fair competition on federally assisted contracts for all enterprises. Although DBE programs set DBE participation goals and offer supportive services, DBEs are rarely successful and still experience significant participation barriers, performance impediments, and development hindrances. With limited studies focusing on DBE success, the author investigated multiple interdisciplinary studies for the success of DBEs in the transportation sector. The author used qualitative, quantitative, mixed, and multiple methods in these studies. The quantitative data was collected from DBEs nationwide, DBE directories, DBE program websites, and national databases. The qualitative data was collected from DBEs and DBE liaison officers who were willing to participate in a particular research study. These studies began with describing characteristics of DBE firms and practices of DBE programs. Then, the author identified DBE challenges using both variable clustering technique and principal component analysis. Next, the author proposed a framework for providing supportive services in business, engineering, construction, and other (BECO) categories. The BECO framework revealed useful supportive services to DBEs in construction contracting, engineering consulting, and other business areas. Last but not least, the author summarized common DBE fraud and abuse schemes such as front, pass-through, fabrication, and false claims. Although these studies have limitations, the outcomes provide an understanding of DBE firms and DBE programs, inform policymakers on future regulatory changes, and improve both the experience of DBEs and the quality of DBE programs.

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CHAPTER 1. INTRODUCTION

"Most Engineers run away from studying the DBE [i.e., Disadvantaged Business Enterprise] program. Why did you run toward it?" An experienced research consultant asked me a question over a phone conversation. "Maybe you were running away, but you didn't run fast enough." The consultant's teasing tone made both of us laugh (Dang, 2019).

After briefly describing my background in engineering and construction, I explained that DBE topics resonated with me from three aspects. First, I am in one of the groups (i.e., Asian) that are presumed to be both socially and economically disadvantaged. Because of this, I understand and experience both conscious and unconscious bias and discrimination, which allow me to relate to DBE owners closely. Second, a majority number of DBEs are in either engineering or construction, of which engineering is also called professional services. Since I have an educational background and professional experience in both engineering and construction, I am well prepared me for DBE research studies. My knowledge allows me to understand a large number of DBEs and explores research questions through an interdisciplinary approach. Third, I advocate nondiscrimination, equality, diversity, and inclusion in business and believe these are vital catalytic for economic prosperities. Especially with aging infrastructure, all contractors and engineers must work together effectively under limited federal funds and ever-tightening budgets.

To further explain the motivation of the DBE research, chapter one outlines the following sections: introduction of the topic, background of the problem, research objectives and questions, significance of the research outcomes, organization of the dissertation, and conceptual and operational definition of key terms.

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Introduction of the Topic

Disadvantaged Business Enterprise (DBE) is a for-profit, small business "that is at least 51 percent owned by one or more individuals who are both socially and economically disadvantaged." In the case of a corporation, at least "51 percent of the stock is owned by one or more such individuals" and "whose management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it." Socially and economically disadvantaged individuals include seven groups: Black, Hispanic, Native, Asian-Pacific, and Subcontinent Asian Americans, as well as women or any other individuals determined on a case-by-case basis by the Small Business Administration. These individuals are "subjected to racial or ethnic prejudice and culture bias in American society because of their identities as members of groups without regard to their individual qualities" and their "ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities" (49 CFR §26.5, 2014).

The United States (US) Department of Transportation (DOT) established the DBE program in 1983 under the authority of Title VI of the Civil Rights Act of 1964 to create a "level playing field" for all business enterprises to compete fairly on federally assisted contracts (US DOT, 2016a). The program certifies eligible businesses as DBEs, sets annual DBE goals, and provides supportive services to DBEs. The program aims to overcome DBE participation barriers, support the development of DBEs, and improve DBE performance in federally assisted contracts. Federal funds, collected from all taxpayers, should ensure fair competition in federally assisted contracts for all enterprises without discrimination against individuals from disadvantaged groups. The Code of Federal Regulations (CFR) prescribes the DBE program requirements in Title 49. Particularly, 49 CFR §26 is "Participation by disadvantaged business

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enterprises in department of transportation financial assistance programs," and 49 CFR §23 is "Participation of disadvantaged business enterprise[s] in airport concessions."

Background of the Problem

The problems of DBEs are small, compounded with both socially and economically disadvantaged status (Glover, 1975). Inevitably, these problems create significant barriers for DBEs in the transportation sector, notably diminished contracting opportunities and limited access to resources. The US DOT spends $42 to $46 billion each year between 2016 and 2020 on construction contracts (Fixing America's Surface Transportation Act of 2015). DBEs perform approximately 10 percent (i.e., about $4.4 billion) of the federally assisted contracts. Although the DBE program provides some beneficial support, there are still numerous complex issues for DBE to participate in federally assisted contracts and develop in the DBE program. For instance, most DBEs struggle to grow their business. Some DBEs strategically stay at a comfortable level in the DBE program for a long period, precluding new and emerging DBEs. Additionally, each state provides different, sometimes repetitive and ineffective, supportive services, which can benefit some DBEs and leave out others.

The US DOT revised the final rule of the DBE regulations several times to remove significant barriers for DBEs to participate in federally assisted contracts (Smith, 2005). The regulation requirements changed practices in both state transportation agencies and business enterprises. These practices raised several issues and concerns. First, there were many certified DBEs, yet only a few DBE participated in federally assisted contracts. The US DOT Office of Inspector General (2013) criticized that the DBE program focused on getting DBEs certified rather than helping DBEs participate in federally assisted contracts. Second, DBEs needed supportive services to overcome barriers and improve performance. Most supportive services focused on speed networking (i.e., meet and greet) with limited further assistance in federal

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contracting or business development. Third, DBEs needed assistance to successfully grow their business to a comfortable level and further develop their business to compete outside the DBE program. DBE programs, including supportive services, had no framework or pathways that would allow DBEs to grow or develop in and outside the program successfully. Fourth, pervasive DBE fraud diminished opportunities for legitimate DBEs, diverting federal funds from intended purposes.

This dissertation focus on interdisciplinary studies for the success of DBEs in the transportation sector. Most of these DBEs provide engineering and construction services. Specifically, the problems addressed here are DBE characteristics, DBE challenges, useful supportive services, and common fraud schemes in the DBE program.

Research Objectives and Questions

With four research questions, this research aims to uncover DBE characteristics, reveal DBE challenges, identify useful supportive services, and summarize common DBE fraud schemes in the transportation sector. Each question guides a research study in chapters 4 to 7 of the dissertation. The following is a list of the major and minor research questions.

1. What are the characteristics of DBEs and practices of DBE programs?
    a. What are the characteristics of DBEs in the United States?
    b. What are the practices of DBE programs in the United States?
2. What are DBE challenges in the DBE program?
    a. What are the variable clusters of DBE challenges?
    b. What are the principal components of DBE challenges?
3. What are useful supportive services for DBEs?
    a. What are useful supportive services and adult learning practices?
    b. What is the framework or structure for providing supportive services?

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4. What are the common DBE fraud schemes?

    a. What are statically evidence of DBE fraud and abuse?

    b. What are common DBE fraud and abuse schemes?

Significance of the Research Outcomes

The outcomes of the research have a significant impact on understanding DBE firms and DBE programs, informing policymakers on future regulatory changes, and improving the experience of DBEs and the quality of DBE programs. Understanding the DBE characteristics and challenges can aid state transportation agencies (STAs) to adopt effective practices in the DBE program. The understanding also serves as fundamental literature for future research. Identifying useful supportive services reduces the overall cost of supportive services programs and assists in the development of DBEs. It also enables STAs to provide useful supportive services that meet the needs of DBEs. Discovering common DBE fraud schemes is the first step in DBE fraud detection and prevention, which contributes to raising fraud awareness. Less DBE fraud cases increase contracting opportunities for legitimate DBEs and reduce costs and efforts in DBE fraud investigations.

Furthermore, DBEs contribute significantly to economic development and infrastructure construction. Besides boosting the economy and improving infrastructure, the success of the DBEs can improve efficiency and reduce costs on federally funded projects. Additionally, this study fills the gap of knowledge in previous literature and contributes to the body of knowledge in the fields of civil engineering, construction management, and business administration.

Organization of the Dissertation

This dissertation has eight chapters, in which four chapters (chapters four to seven) are in journal paper formats. Chapter one introduces the research topic. Chapter two reviews relevant literature in chronological order. Chapter three describes the research methodology and lays a

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foundation for the studies in the subsequent chapters. Chapter four provides an overview of the DBEs, including regulations, programs, and supportive services. Chapter five uncover DBE challenges using variable clustering technique and principal component analysis. Chapter six introduces a proposed framework for providing useful supportive services. Chapter seven summarizes common fraud and abuse schemes in the DBE program. Chapter eight synthesizes previous chapters and provides general conclusions, limitations, and future research.

Conceptual and Operational Definition of Key Terms

A definition of terms allows interdisciplinary research to synthesize knowledge from different disciplines and helps avoid cognitive dissonance in different settings such as culture, knowledge, context, history, linguistics, and cognition. The author either operationally adapted or conceptually defined terms here below for clarity, consistency, and reliability.

Author (or The Author): is the author of the dissertation, Hongtao Dang. The author spells out the name of other researchers or entities to avoid confusion.

Alaska Native Corporation (ANC): any Regional Corporation, Village Corporation, Urban Corporation, or Group Corporation organized under the laws of the State of Alaska in accordance with the Alaska Native Claims Settlement Act, as amended (43 U.S.C. 1601, et seq.).

Black Americans: persons having origins in any of the Black racial groups of Africa.

Hispanic Americans: persons of Mexican, Puerto Rican, Cuban, Dominican, Central or South American, or other Spanish or Portuguese culture or origin, regardless of race.

Native Americans: persons who are enrolled members of a federally or State recognized Indian tribe, Alaska Natives, or Native Hawaiians.

Asian-Pacific Americans: persons whose origins are from Japan, China, Taiwan, Korea, Burma (Myanmar), Vietnam, Laos, Cambodia (Kampuchea), Thailand, Malaysia, Indonesia, the

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Philippines, Brunei, Samoa, Guam, the US Trust Territories of the Pacific Islands (Republic of Palau), Republic of the Northern Marianas Islands, Samoa, Macao, Fiji, Tonga, Kiribati, Tuvalu, Nauru, Federated States of Micronesia, or Hong Kong.

Subcontinent Asian Americans: persons whose origins are from India, Pakistan, Bangladesh, Bhutan, the Maldives Islands, Nepal or Sri Lanka.

Socially and economically disadvantaged individual: any individual who is a citizen (or lawfully admitted permanent resident) of the United States and who has been subjected to racial or ethnic prejudice or cultural bias within American society because of his or her identity as a member of groups and without regard to his or her individual qualities. The social disadvantage must stem from circumstances beyond the individual's control.

Business, *business concern* or *business enterprise*: an entity organized for profit, with a place of business located in the United States, and which operates primarily within the United States or which makes a significant contribution to the United States economy through payment of taxes or use of American products, materials, or labor.

Contract: a legally binding relationship obligating a seller to furnish supplies or services (including, but not limited to, construction and professional services) and the buyer to pay for them. For purposes of this study, a lease is considered to be a contract.

Contractor: one who participates, through a contract or subcontract (at any tier), in a DOT-assisted highway, transit, or airport program.

Good faith efforts: efforts to achieve a DBE goal or other requirement which, by their scope, intensity, and appropriateness to the objective, can reasonably be expected to fulfill the program requirement.

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Recipient: any entity, public or private, to which DOT financial assistance is extended, whether directly or through another recipient, through the programs of the FAA, FHWA, or FTA, or applicant.

Race-conscious measure or program: one that is focused specifically on assisting only DBEs, including women-owned DBEs. Race-conscious measures include gender-conscious measures.

Race-neutral measure or program: one that is, or can be, used to assist all small businesses. For the purposes of this part, race-neutral includes gender-neutrality. Race-neutral measures include gender-neutral measures.

Ready, Willing, and Able (RWA) DBEs: Certified DBEs that are ready, willing, and able to work on federally assisted contracts. RWA is a common terminology describing the status of certified DBEs in the DBE program.

Success: The accomplishment of an aim or purpose. Successful DBEs are capable of either maintaining or growing business to a comfort level.

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"Fixing America's Surface Transportation Act" or the "FAST Act" (P.L. 114-94, Dec. 4, 2015).

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CHAPTER 2. LITERATURE REVIEW

Listening to the committee meeting session for the Department of Transportation's Disadvantaged Business Enterprise Programs on March 26, 2009, the author transcribed two testimonies by Ms. Katherine Cloonen and Mr. Dennis Kim below, respectively. Ms. Cloonen is the president and owner of JK Steel Erectors, Inc. She started the small construction company in 1991 specialized in rebar and wire mesh installation in concrete and structural steel erection for transportation and other projects. She illustrated a few examples of gender discrimination in the construction industry.

> *Discrimination has been and still is a factor for women and minorities in the construction business…. Often I will get a call asking for the person in charge of estimating, and I say that I am that person. Then the caller hangs up. Once in a while, the person says well I want the boss or the man-in-charge, and I say I am the boss, I'm the man-in-charge, and I still hear a click on the other end of the phone…. Women are not afforded the networking opportunities that men are allowed, and without the DBE program, many prime contractors just would not hire me.* (HouseResourceOrg, 2011).

Similarly, Mr. Kim is the president and owner of EVS, Inc. EVS started in 1979, certified as a DBE since 1984, and had been providing civil and electrical engineering, land surveying, and environmental permitting services. Mr. Kim discussed his experience of racial discrimination in the transportation sector.

> *I want to talk about one incident which made me humiliated as a small business owner in 1998. I first learned about a subcontracting opportunity with a white-owned company. It was a highway design project with [the] Rochester District and Minnesota Department of Transportation. The company was successful in winning the contract.*

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The contract was to design several miles of highway. EVS was chosen as a subcontractor because we had contacted that company about this project. Also, there was a DBE requirement. However, the project was delayed over a year because [the] scope of the project had been expanded after [the] contract was awarded. Then, there had been a number of issues with the project, including [the] expanded scope of work, delay of the work, and other engineering problems. In 2003, I was summoned to a meeting in Rochester. When I walked in, there were three people in the room from the company and DOT. They were all white male Caucasians. I was told that I was at fault for the many problems with the project. Then they kicked me off the project even with my protest. Later on, they hired another subcontractor owned by a Caucasian male. I feel that their reason for unfairly targeting me in this way is that I am an Asian American. They would not have done this to me if I were Caucasian.

(HouseResourceOrg, 2011).

Besides the testimonies above, these were historical, anecdotal, and statistical evidence of discrimination that created significant barriers for DBE participation in federal contracting. The remainder of this chapter is a comprehensive literature review in chronological order focusing on the following topics: 1) historical review of DBEs and DBE programs and 2) contemporary overview of DBEs and DBE programs.

The literature on DBE spreads across multiple disciplines in many different journals and conference proceedings, legal cases and reviews, government audits and reports, public comments and news, and research programs and initiatives. Since creating a literature review map is a helpful technique to visualize connections and relative relationships among various literature, the author illustrates a visual map of relevant literature on DBEs from 1975 to 2018 in

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Figure 1. The map is not an exhaustive visualization of DBE literature and delineates a wide range and a thin spread of different research topics and objectives in previous literature. The DBE, centered in the five circles, has four major sources of literature including 1) reports and syntheses; 2) scholar publications and journal papers; 3) law, regulation, policies, and comments; and 4) books related to small and disadvantaged businesses, entrepreneurship and leadership, and research methods. Each source has literature references in a few subcategories. For instance, reports and syntheses are available from the US Government Accountability Office (GAO), US Department of Transportation (DOT), and US Transportation Research Board (TRB) National Cooperative Highway Research Program (NCHRP).

Common themes in the literature are related to topics such as regulations, legal affairs, programs, performances, development, and procurement. A common concern in the DBE literature is data availability and reliability due to insufficient recordkeeping or incomplete database. Because of the concern, the author decides to combine various literature sources to maximize data availability and illustrate DBEs from a holistic perspective.

Additionally, the author decides to present literature in chronological order, which allows different research studies to be placed in a proper contextual setting with succinct and accurate information about DBEs and DBE programs under the applicable laws and effective regulations. For example, Beliveau et al. studied a set-aside DBE program in 1991 under the effective DBE final rule in 1983. The DBE final rule in 1999 neither allowed set-asides or quotas in the DBE program.

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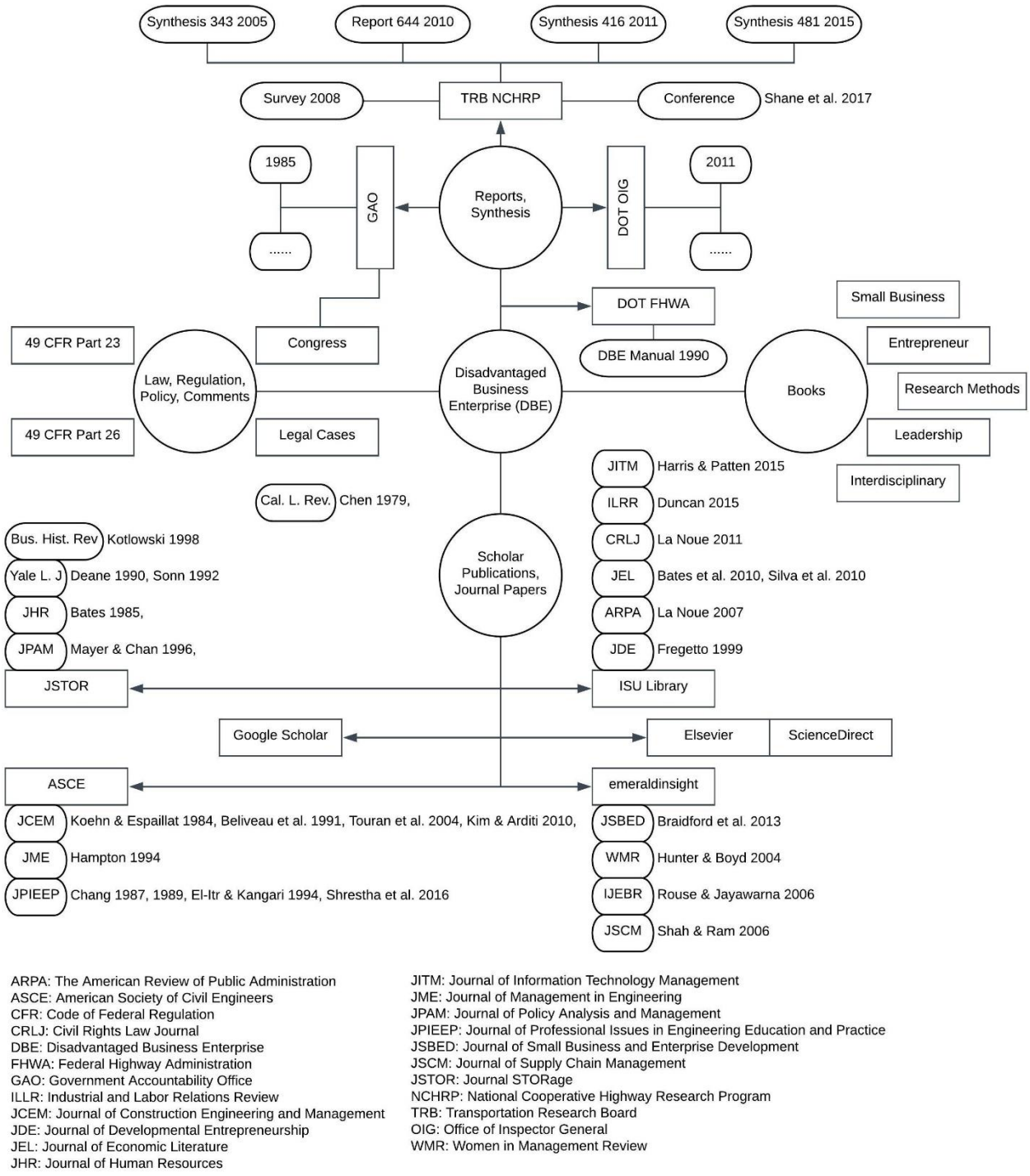

Figure 1. Visual Map of Relevant Literature.

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Historical Review of Disadvantaged Business Enterprise

The historical review of DBE presents literature between 1964 and 2019 in chronological order, including topics related to both MBE and DBEs. Early research studies focused on MBEs, especially African (i.e., Black) Americans. Then, studies on DBEs emerged after the inception of the DBE program in 1983. Thereafter, Congress reauthorized the DBE program and revised the DBE final rule multiple times based on congressional debates, scholar studies, governmental reports, legal cases, and court rulings. The following text formats purposefully distinguish different literature at the beginning of each paragraph by the following:

- Law, regulation, and policy are <u>Underlined</u>
- Legal cases and court rulings are *Italic*
- Final DBE rules are **bolded**
- Scholar studies are labeled with the author(s) (year)
- Regular (i.e., unformatted) text are contextual information and critical discussions of regulation changes, political climates, or conflicted arguments.

The US Small Business Administration (SBA), created in 1953, aims “to aid, counsel, assist, and protect the interests of small business concerns, to preserve free competitive enterprise and to maintain and strengthen the overall economy of our nation” (US SBA, 2019). Similarly, the fifteen executive departments dedicate offices and programs to ensure fair competition and provide assistance for small and disadvantaged businesses. Particularly, the Department of Commerce (DOC) manages the Minority Business Development Agency (MBDA), which "promotes the growth of the minority-owned business through the mobilization and advancement of public and private sector programs, policy, and research" (US DOC, 2019). The Department of Transportation (DOT) oversees the Disadvantaged Business Enterprise

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(DBE) program, which ensures fair competition for all businesses through remedying both ongoing discrimination and the effects of past discrimination in federally assisted contracts (US DOT, 2016a).

Minority Business Enterprises

The Civil Rights Act of 1964, signed by President Lyndon B. Johnson, prohibits discrimination in public places based on race, color, religion, sex, or national origin. After the Emancipation Proclamation stated all slaves "shall be then, thenceforward, and forever free" in 1863, approximately 3.5 million Black Americans became free and hoped for equality at work and in life. However, Black Americans still struggled with getting equal civil rights and a new identity in the following decades. Many lived in southern states under poverty, inequality, racial segregation, and discrimination with limited access to public transits, schools, restaurants, or hotels. Because of these conditions, Black Americans were barely able to find work and even rarely started a business in construction.

Following the Civil War and Emancipation, the railroad expansion created many jobs and stimulated economic growth between 1860 and 1900. Shortly, the needs in highway construction increased at large as automobiles proliferated. Consequently, the federal government allocated funds on highway construction through the Federal Aid Road Act of 1916 and the Federal Highway Act of 1921. Subsequently, Congress enacted the Federal-Aid Highway Acts of 1938, 1944, 1952, 1956, 1962, 1973, 1976, and 1981 to allocate federal funds for highway construction constantly. Years between 1950 and 1970 became the great road-building era and the golden age of capitalism in America. The government did not regulate many aggressive and unfair business tactics. Particularly, Black Americans did not have equal privilege and faced significant social and economic barriers in businesses, especially federal contracting. Some minority businesses

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benefited from executive orders and initiatives from Presidents Lyndon B. Johnson and Richard M. Nixon. However, Black capitalism only emerged at the end of the golden age of capitalism.

The US Commerce Department (i.e., Department of Commerce) established the Office of Minority Business Enterprise (OMBE) under the support of President Nixon. Nixon supported minority business enterprise (MBE) in his presidential campaign in 1968 and worked with Commerce Secretary Maurice H. Stans on the MBE program throughout his presidency (Kotlowski, 1998). The OMBE encouraged minority entrepreneurship, expanded procurement from MBEs, and increased the deposit of federal funds in minority banks. Nixon requested support and effort to "develop a program which will increase the involvement of minority group contractors in the multibillion-dollar Federal procurement program." Ways to support the efforts were to "provide procurement opportunities, supply management, and technical experts; help to set goals to measure the progress of the efforts being made; and name a representative of your department or agency to pursue these efforts." Contract procurement goals yielded significant minority business growth between 1969 and 1991. However, Nixon refused to extend procurement goals to minority construction firms. Only MBEs in southern California benefited from the Los Angeles Plan, in which the city restricted a certain volume of federal contracts to minority construction firms. The OMBE influenced federal policy toward minorities for decades, became the Minority Business Development Agency (MBDA) later, and continued to "promote the growth of the minority-owned business through the mobilization and advancement of public and private sector programs, policy, and research." (US MBDA, 2019)

Glover (1975) published a final report titled "Fostering Minority Enterprise in Construction" based on 640 interviews with contractors and civil rights officials. The report investigated the profile of minority contractors, obstacles, and approaches to upgrading the

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minority contractors, joint ventures, and minority contractor associations. Glover identified 1,275 and interviewed 315 minority contractors in the four metropolitan areas: Atlanta, Huston, Chicago, and San Francisco-Oakland. The interviewed contractors had an average of 11 years of contracting experience and were 45 years old on average. Most MBE contractors started as craftsmen and became contractors with an average of 21.7 years of experience. However, only a few MBE contractors received formal training in federal contracting or business management. Although some successful minority contractors learned their skills in black colleges, approximately half of them had neither business experience nor training before establishing their construction firms. Glover concluded, "Minority contractors face the problems of being small, compounded by problems of their minority status" and recommended demand stimulation and supply development to upgrade minority contractors. The demand stimulation approaches were "identifying minority firms in published listings" and "directing procurement of Government and Government contractors at minority firms." The supply development efforts were "delivering bonding and financial assistance, managerial and technical help, and labor training."

Disadvantaged Business Enterprises

The US Department of Transportation (DOT) established a minority business enterprise program in 1980 and changed the program name to Disadvantaged Business Enterprise (DBE) program in 1983. In the next few decades, Congress revised the DBE final rule and reauthorized the DBE program many times. Figure 2 illustrates the timeline of DBE rulemaking with relevant DBE regulations and laws. The following paragraphs describe significant changes in the final rule before presenting literature in the effective period of the final rule.

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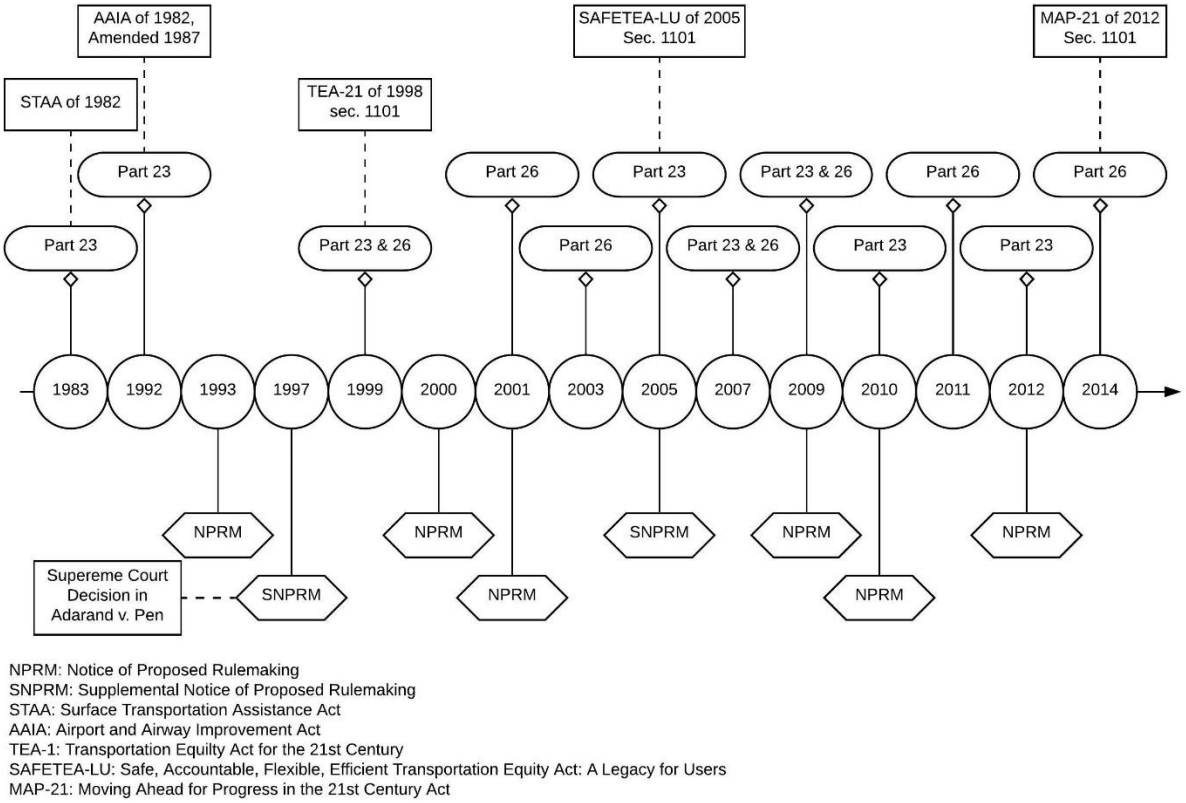

Figure 2. DBE Rulemaking Timeline and Relevant DBE Laws.

Congress enacted the Surface Transportation Assistance Act (STAA) of 1982 into Public Law 97-424 on Jan 6, 1983. The following is the statute from the STAA, Section 105(f).

> *Except to the extent that the Secretary determines otherwise, not less than ten per centum of the amounts authorized to be appropriated under this Act shall be expended with small business concerns owned and controlled by socially and economically disadvantaged individuals as defined by section 8(d) of the Small Business Act (15 U.S.C. 637(d)) and relevant subcontracting regulations promulgated pursuant thereto.*

Under the STAA of 1982, the US DOT issued the **first DBE final rule** (i.e., 49 CFR §23) on July 21, 1983, and the rule became effective on August 22, 1983. The rule, 49 CFR §23 Participation by Minority Business Enterprises in Department of Transportation Programs, prescribed the DBE program requirements that the DBE participation should be at least ten

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percent of the overall federal funds allocated toward highway contracts. The requirements intended to ensure fair competition and nondiscrimination in federal contracting under the authority of Title VI of the Civil Rights Act of 1964 and the STAA of 1982. The initial rule did not include women-owned business enterprises at the moment; thus, it was often referred to as the MBE rule.

Scholars found the DBE program slightly increased the costs of construction projects and attracted some young minority entrepreneurs into the construction industry. Koehn and Espaillat (1984) investigated the costs and benefits of the MBE rule in construction based on survey responses from 193 companies representing 10 billion dollars of construction contracting work. The study revealed that the costs of construction projects had a minor increase due to the MBE rule. Large contractors had fewer difficulties complying with the MBE rule, compared with relatively medium or small contractors. Although the number of minority contractors increased, the number of qualified minority contractors remained the same. Most respondents recommended revising the MBE rule since it negatively influenced their profitability and changed the way they used to do business. Differently, minority contractors maintained and some increased profitability with procurement efforts from agencies, good faith efforts from nonminority firms, and training from DBE programs. Sampling MBEs from Dun and Bradstreet Financial Profiles database, Bates (1985) found a subset of well-educated minority entrepreneurs shifted their businesses from retailing and personal services to manufacturing, contracting, and labor-intensive services. The DBE program encouraged young minorities with better education and greater government commitment to participate in federally assisted contracts through the DBE program. These minority entrepreneurs earned relatively high profits by using both financial and human capital effectively.

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Congress enacted the Surface Transportation and Uniform Relocation Assistant Act (STURAA) of 1987 into Public Law 100-17 on January 6, 1987. Section 106(c) listed five key provisions below:

(1) ten percent (10%) of the funds authorized in the Act must be expended with small business concerns owned and controlled by socially and economically disadvantaged individuals;

(2) Women are included in the presumptively disadvantaged category. Women are, therefore, presumed to be socially and economically disadvantaged and as such come under the 10 percent participation requirement;

(3) The Small Business Administration definition of eligibility is retained, but the size standard limitation is set at $4 million of the average annual gross receipts over the three previous fiscal years;

(4) Each State must annually survey and list the firms certified in that State including their locations; and

(5) Certification of DBEs by State governments according to minimum uniform criteria established by the Secretary is required. Such minimum uniform criteria include, but are not limited to, on-site visits, personal interviews, licenses, analysis of stock ownership, [a] listing of equipment, analysis of bonding capacity, [a] listing of work completed, resumes of principal owners, financial capacity, and type of work preferred.

Chang (1987) noted continuous controversies with DBE participation in DOT-financial assistance programs and explored potential suggestions for increasing DBE participation. The research first collected interviews from 57 bankers, 50 bonding agents, and 11 officers from government and trade associations. Chang summarized 33 suggestions in four major

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classifications: finance, bonding, training and education, and others. Based on these suggestions, Chang then developed a questionnaire, sent to 1,120 non-DBE contractors and 386 DBE contractors, and received 167 and 73 responses, respectively. Both DBE and non-DBE contractors genuinely agreed four out of the top five suggestions in each classification. However, the best way to increase DBE participation in the construction industry was seen differently from different perspectives. DBE contractors suggested to "relax bonding requirements for governmental work" whereas non-DBE contractors advocated to "increase construction training opportunities by using local school and college facilities." Chang (1989) further differentiated difficulties encountered by DBE and non-DBE contractors using statistical tests. Significant differences existed between DBE and non-DBE contractors. One major difference was that DBEs tended to have more difficulties in the construction industry compared to non-DBE contractors. Under the DBE program, the set-aside 10% DBE participation requirement differentiated DBEs from non-DBEs and changed the way they conducted their business. DBEs relied on the DBE participation requirement. Large non-DBEs had to use DBEs to comply with contract requirements on some projects. Small non-DBEs sometimes had to compete against and lost contracting opportunities to DBEs.

City of Richmond v. J.A. Croson (1989) challenged the municipal requirement that at least 30% of contract value should be subcontracted to MBEs. The City of Richmond adopted DBE regulations and required general contractors to subcontract 30% of an awarded contract to MBEs as set-aside. Because of the 30% set-aside, the J.A. Croson lost contracts and brought suit against the city. The Court applied strict scrutiny and distinguished the power of local governments to redress discrimination within their borders from the power of Congress to remedy general societal discrimination. In a 6-to-3 decision, the Court held that “generalized

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assertions" of past racial discrimination could not justify "rigid" racial quotas for the awarding of public contracts. The Court concluded that the city failed to demonstrate "a compelling interest" for remedying discrimination because there was no evidence of discrimination against MBEs. The preferential classification should only entitle minority groups, "whose societal injury is thought to exceed some arbitrary level of tolerability."

Because of various interpretations of DBE regulations and increasing legal challenges, FHWA (1990) published a DBE program administration manual. The manual provided guidance for DBE goal approval procedures, certifications, contract administrations, supportive services, and complaints and appeals. This manual prescribed the determination of good faith efforts in the contract compliance section to alleviate the overburden of the minimum 10% DBE participation requirement on federally assisted contracts. Additionally, the contract compliance section described the mentor-protégé program as an optional approach. This manual had a short section for DBE supportive services and described available funds for supportive services. Some preferred supportive services included, but were not limited to, assistance on identification, prequalification, certification, estimating, bidding, technical training, business management, recordkeeping, accounting, obtaining bonds, and any other supportive services on increasing the total number of legitimate DBEs, developing capabilities and technical skills in highway construction, and improving business performance and management.

Congress enacted the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 into the Public Law 102-240 on December 18, 1991. The act reaffirmed that DBE should participate by "not less than 10 percent of the amounts made available for any" federally assisted programs.

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Beliveau et al. (1991) criticized the DBE program was a set-aside program and did not contribute to the development of DBEs. Beliveau et al. asserted that the program fed money to DBEs and made them dependent on the set-aside program. Beliveau et al. proposed a new model to invest knowledge and assistance in DBEs and develop them into qualified independent firms. The new model embraced four attributes, including a strong desire to succeed, technical competence, managerial competence, and access to the necessary resources. The proposed DBE program consisted of five primary steps: "(1) locate and recruit promising minorities; (2) evaluate skill levels and provide the necessary educational assistance; (3) assist DBEs with the resources needed to start and run a highway construction business; (4) monitor the DBEs' progress and provide the necessary assistance; and (5) wean DBEs from the program." Shane et al. (2017) noted that some peer scholars perceived bias in the use of the terms "recruit," "promising," "start," and "wean."

The US DOT issued a **new DBE final rule** (i.e., CFR 49 §23) on April 30, 1992, and the rule became effective on June 1, 1992. The rule established requirements for the participation of DBEs in airport concessions per the Airport and Airway Improvement Act of 1982, as amended in 1987 to include women in the presumably disadvantaged groups.

El-Itr and Kangari (1994) proposed a new Equal Business Opportunity (EBO) program for the city of Atlanta based on interviews and surveys from contractors. El-Itr and Kangari identified several drawbacks of the existing EBO program, such as increased costs of construction projects, benefited only a few minority contractors, lacked the training to minority contractors, and exposed non-DBEs to potential reverse discrimination. Based on data analysis, El-tri and Kangari concluded that the new EBO program should eliminate the mandatory

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minority goal requirement, assist minority contractors selectively, and reduce the government's involvement in the construction industry.

Myers and Chan (1996) studied the minority business (i.e., set-aside) program in New Jersey and concluded the program did not reduce the discrimination against minority businesses. Myers and Chan found discrimination existed "in the award of contracts but not in the dollar amount of contracts awarded." The discrimination existed regardless of the existence of the set-aside program. The set-aside program is a remedy for past discrimination rather than a solution for on-going discrimination.

Adarand Constructors, Inc. v. Pena (1995 and 1997) challenged the incentive payments to prime contractors whose subcontracts with DBEs exceeded 10% of the total contract value. The Court concluded that the DOT incentive program was not narrowly tailored because benefits were available to all minorities regardless of disadvantages and would exclude disadvantaged whites. Additionally, the Court held that "since race is not a sufficient condition for a presumption of disadvantage and the award of favored treatment, all race-based classifications must be judged under the strict scrutiny standard. Moreover, even proof of past injury does not in itself establish the suffering of present or future injury."

Congress enacted the Transportation Equity Act for the 21st Century (TEA-21) into the Public Law 105-178 on June 9, 1998. Section 1101 (b) reaffirmed that "not less than 10 percent of the amounts made available for any" federally assisted program should be expended from DBEs.

The US DOT issued a **new DBE final rule** (i.e., 49 CFR §23 and §26) on February 2, 1999, and the rule became effective on March 4, 1999. Shortly thereafter, the US DOT issued a correction of the rule to ensure the confidentiality of personal financial information, and the rule

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became effective on June 28, 1999. The final rule rewrote the DBE program with substantial revisions. The statutory 10 percent goal became an aspirational goal at the national level. In the new rule, neither set-asides nor quotas were part of the program. The DBE program refined the purpose to "remedy past and current discrimination against DBEs, ensure a ‘level playing field' and foster equal opportunity in DOT-assisted contracts, improve the flexibility and efficiency of the DBE program, and reduce burdens on small businesses." The program required "narrow tailoring" under applicable law to reduce legal challenges. The program established seven objectives below.

(a) *To ensure nondiscrimination in the award and administration of DOT-assisted contracts in the Department’s highway, transit, and airport financial assistance program;*

(b) *To create a level playing field on which DBEs can compete fairly for DOT-assisted contracts;*

(c) *To ensure that the Department’s DBE program is narrowly tailored in accordance with applicable laws;*

(d) *To ensure that only firms that fully meet this part’s eligibility standards are permitted to participate as DBEs;*

(e) *To help remove barriers to the participation of DBEs in DOT-assisted contracts;*

(f) *To assist the development of firms that can compete successfully in the marketplace outside the DBE program; and*

(g) *To provide appropriate flexibility to recipients of Federal financial assistance in establishing and providing opportunities for DBEs.*

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Fregetto (1999) studied 149 contracts awarded to DBEs and 649 contracts awarded to Non-DBEs using a multiple regressional policy model consisting of five economic factors including financial aspects, low-bid position, consumer price index change, competition, and estimating tactics. The study uncovered that the DBE program provided little assistance to DBEs; non-DBEs still had distinctive competitive advantages compared with DBEs. The study recommended that both race-neutral measures and management assistance should be essential parts of an efficient DBE program.

The US DOT issued an **interim final rule** (i.e., 49 CFR §26) on November 15, 2000. This rule changed threshold requirements for recipients to establish the DBE program in the Federal Transit Administration and Federal Aviation Administration. The rule required recipients to track and report both commitments and attainments of the DBE goal. Also, the rule corrected potential misleading languages in the overall goal-setting.

Adarand Constructors, Inc. v. Slater, 228 F. 3d 1147 (10th Cir. 2000) concluded that the new DBE program, as revised under the post-Adarand DOT regulations, was constitutional.

Rothe Development Corporation v. US Department of Defense, 262 F. 3d 1306 (Fed. Cir. 2001) imposed a heavy burden on the federal government to demonstrate the necessity for minority contracting preferences. The federal government must produce evidence of pre-enactment discrimination to uphold and reauthorize §1207 of the National Defense Authorization Act of 1987.

The US DOT issued a **new DBE final rule** (i.e., 49 CFR §26) on June 16, 2003, and the rule became effective on July 16, 2003. The rule addressed comments received in response to the interim final rule of 2000 and notices of proposed rulemaking. The rule had several revisions regarding the uniform application and reporting forms, implementing a memorandum of

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understanding with the Small Business Administration, clarification of multi-year project goals, and the use of the North American Industrial Classification System (NAICS). Besides, the rule had substantive amendments to provisions concerning personal net worth, amount of retainage, size standard, proof of ethnicity, confidentiality, proof of economic disadvantage, DBE credit for trucking firms, and eligibility of firms owned by Alaska Native Corporations (ANCs).

Sherbrooke Turf, Inc. v. Minn. Dep't of Transp., 345 F. 3d 964 (8th Cir. 2003) and *Gross Seed Co. v. Dep't of Transp.*, 345 F. 3d 964 (8th Cir. 2003). Minnesota and Nebraska state DOTs established specific goals for the award of federally funded contracts to DBEs in compliance with the US DOT regulations. Both *Sherbrooke* and *Gross Seed* were subcontractors providing landscaping services to prime contractors on federally assisted projects. When contracts were awarded to DBEs under the DBE program, *Sherbrooke* and *Gross Seed* suffered competitive harm and sued state DOT for their constitutional rights. Because the DBE program was enacted by Congress with a showing of compelling interest to remedy race discrimination in federal highway contracting at the federal level, the Court concluded that neither Minnesota DOT nor Nebraska road department was required to make an independent showing of compelling interest that the program was narrowly tailored as implemented at the state level.

Touran et al. (2004) investigated prompt pay provisions in the DBE regulation and reported a 4.35% decrease in contractor's profit and a 0.14% increase in costs of transportation projects. The provision required the general contractor to pay subcontractors within a given number of days from the receipt of each payment from the owner. Also, general contractors should release retainage to DBEs within a given number of days from the time that the DBE's work has been satisfactorily completed regardless of the work progress or retainage status of the general contractor. Touran et al. performed a cost analysis in a cash flow model for eight

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projects. The profit reduction ranged from 2.2% to 7.0%, and contract cost increased from 0.07% to 0.23%.

Congress enacted the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) into the Public Law 109-59 on August 10, 2005. The Act reaffirmed DBE participation in federally assisted contracts.

The US DOT issued a **new DBE final rule** (i.e., 49 CFR §23) for airport concessions on March 22, 2005, and the rule became effective on April 22, 2005. The rule aligned with the Department's DBE regulation (i.e., 49 CFR §26) for federally assisted contracts in many aspects. The rule addressed goal-setting, personal net worth, business size standards, and counting car rental companies in the DBE participation of the airport concessions.

Western States Paving Co., Inc. v. Washington State Dep't of Transp., 407 F. 3d 983 (9th Cir. 2005). The 9th circuit ruled that TEA-21st DBE regulations should be narrowly tailored to MBE and WBE preferences. Also, the regulations prohibited the use of quotas and required states to meet its maximum goal by using race-neutral means. The government had a compelling interest in ensuring that federal funding was not distributed in a way that reinforced the effects of discrimination within transportation-related construction. California DOT adopted a race-neutral policy because it could not show sufficient evidence that minority groups had suffered discrimination in the federally assisted contracts.

National Cooperative Highway Research Program (NCHRP) published the synthesis 343: Management of Disadvantaged Business Enterprise Issues in Construction Contracting (Smith, 2005). The synthesis collected survey responses from 36 state transportation agencies (STAs) for organizational information, functions, and sizes of each DBE program. Each state managed the DBE program in different ways. Most STAs placed the DBE program in the civil rights office.

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Few STAs managed the DBE program in their construction contract administration groups. STAs experienced an increase in new certification on average, and the number of ready, willing, and able DBEs had increased in 13 states and remained the same in 14 states. Most STAs used split goals, including race-neutral and race-conscious approaches. The race-neutral approach means a DBE can participate in federally assisted contracts without setting a DBE participation goal in an individual contract. The race-conscious approach means a specific DBE participation goal is determined and mandated in a federally assisted contract. Smith stressed the need for future research in four areas: "program effectiveness and performance measures, technical and administrative issues, best practices, and resource issues."

The US DOT issued a **new DBE final rule** (i.e., 49 CFR §23) on April 2, 2007, and the rule became effective on May 2, 2007. The rule amended dollar limits in the definition of small businesses and business size limits considering inflation to ensure equal opportunity and fair competition for DBEs. The DOT corrected reference errors in a previous final rule.

La Noue (2008) collected 5,385 contracts awarded by 432 recipients totaling $1.94 billion in the fiscal year 2004. La Noue found that white women were the primary beneficiary of the awards due to the over-utilized race-conscious DBE participation goals in airport concessions. The race-conscious goals did not remedy possible discrimination against the DBE firm, especially minority firms.

The Center for Survey Research (2008) conducted national DBE program manager surveys and collected 69 individual responses in fall 2008. Managers indicated that the state DBE program was facing five problems, including "1) DBE program administration, 2) issues with federal highway administration, 3) goal-setting issues, 4) DBE issues with majority contractors, and 5) construction-related issues in DBE programs." Survey committees

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summarized the findings in bullet points for each topic area. Although Ralph Sanders, one of the survey committee members, conducted a content analysis on the qualitative data based on keywords, a more rigorous qualitative analysis method could have been used to interpret the rich contextual data.

The US DOT issued a **new DBE final rule** (i.e., 49 CFR §23 and §26) on April 3, 2009, and the rule became effective on April 3, 2009. The rule amended the eligible small business size limits based on the 2009 inflation adjustment.

The US DOT issued a **new DBE final rule** (i.e., 49 CFR §23) for federally assisted contracts on April 1, 2010, and the rule became effective on April 1, 2010. The final rule removed the "sunset" provision from 49 CFR §26 since the provision was originally intended for 49 CFR §23 airport concessionaire DBEs.

NCHRP (Wainwright and Holt, 2010) published report 644 guidelines for conducting a disparity and availability study for the federal DBE program. Wainwright and Holt focused on "analysis of the federal DBE goal-setting regulations and case law in all federal circuits considering challenges to the constitutionality of the US Disadvantaged Business Program." This study improved the DBE program and reduced legal challenges.

Kim and Arditi (2010) compared the performance of construction firms between DBEs and non-DBEs in transportation projects. Kim and Arditi first reviewed contemporary performance measurement tools in previous literature. Then, they developed a performance assessment model, including issues in seven areas: financial, customer satisfaction, internal business, learning and growth, safety, technological innovativeness, and quality management. These seven areas consisted of 13 performance factors, in which each factor is a question rated on a five-point Likert scale. Kim and Arditi collected 82 responses from DBE firms and 50 from

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non-DBE firms. Large companies reported similar performance regardless of DBE status. However, small DBE firms struggled in financial, customer relationships, learning and growth, and technological support compared to peer non-DBE firms.

The US DOT issued a **new DBE final rule** (i.e., 49 CFR §26) on January 28, 2011, and the rule became effective on February 28, 2011. Following is a summary of some changes to DBE regulation 49 CFR §26.

- Only terminated a DBE with written consent for a good cause and not for the convenience of the prime contractor
- Increased the personal net worth (PNW) cap from $750,000 to $1.32 million to account for inflationary adjustment.
- Revised interstate certification to create a uniform certification and ease certification in states other than the home state.
- The required recipient to add an element to their DBE program to foster small business participation in contracts.

NCHRP published the synthesis 416: Implementing Race-Neutral Measures in State DBE Programs (Casey et al., 2011). The synthesis surveyed 47 out of 50 states, evaluated 22 race-neutral measures, described 17 strategies for implementing race-neutral measures, and discussed 11 state DBE program challenges and solutions. Casey et al. classified race-neutral measures in four categories, including supportive services and training, administrative support, marketing and outreach, and financial assistance. Casey et al. neither exclusively defined race-neutral measures nor distinguished responsible parties. One race-neutral measure (e.g., technical assistance and education) included overlapping content with another. Also, a race-neutral measure (e.g., marketing) provided by the DBE program would be different if provided by supportive services

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for DBEs. Survey responses indicated the different interpretations of race-neutral measures, "a measure viewed as race-neutral by one state may not be considered race-neutral in another" and "the same measure may be implemented differently" in different states. On average, the most used race-neutral measures were supportive services and training. The least used race-neutral measures were financial assistance. The top five race-neutral measures were listed below, combining the results as effective, very effective, and extremely effective ratings.

(1) Branding, marketing, and publicizing the state's DBE programs, creating a DBE directory, and/or providing information through outreach events, publications, websites, and other vehicles.

(2) Providing firms with one-on-one business reviews and/or technical assistance.

(3) Providing training classes and technical education.

(4) Assisting firms in using technology, such as electronic bidding, website development, and conducting business over the internet.

(5) Providing firms with business development assistance, such as marketing and training assistance or help with business management, business plans, or financial statements.

De Silva et al. (2012) compared subcontracting cost structure and bidding behavior of firms bidding on asphalt paving and surface treatment projects with or without DBE contract goals in Texas. De Silva et al. collected empirical cost data through an equilibrium bidding function and analyzed the data using a nonparametric structural approach. The empirical results indicated a minimum difference in cost estimates or bidding prices between projects with and without a DBE contract goal.

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Congress enacted the Moving Ahead for Progress in the 21st Century Act (MAP-21) into the Public Law 112-141 on June 29, 2012. The Act reaffirmed DBE participation in federally assisted contracts.

The US DOT issued a **new DBE final rule** (i.e., 49 CFR §23) on June 20, 2012, and the rule became effective on June 20, 2012. This final rule amended the airport concessionaire DBE regulation to confirm it in several aspects to the DBE rule in 49 CFR §26. This rule adjusted small business size limits and personal net worth for inflation.

The US DOT Office of Inspector General (2013) published an audit report titled "Weaknesses in the Department's Disadvantaged Business Enterprise Program Limit Achievement of Its Objectives." The report examined the DBE program and interviewed department representatives, state representatives, and DBE firms. The Office of Inspector General (OIG) also collected survey responses from nine randomly selected states and 121 DBE firms with more than ten years of working experience on federally assisted projects. The OIG found inadequate program management, lack of clear DBE guidance and effective DBE training, and absence of an accountable liaison for the program. As a result, the program certified more DBEs while ready, willing, and able DBEs remained the same. DBEs, especially small firms, were unsuccessful in finding opportunities and obtaining federally assisted contracts. The program offered no incentive for DBEs to grow and compete in the marketplace outside the DBE program, which left DBEs in the program indefinitely. The program tended to provide a competitive advantage over non-DBE firms. The OIG summarized eight recommendations. The deputy secretary of transportation responded to these recommendations with either “concur” or “concur in part” to improve the DBE program.

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The US DOT issued a **new DBE final rule** (i.e., 49 CFR §26) on October 2, 2014, and the rule became effective on November 3, 2014. The final rule improved the DBE program in three major areas. First, the rule revised the uniform certification application and reporting forms, created a uniform form for personal net worth, and required data collection per MAP-21. Second, the rule added a new section authorizing suspensions of DBEs under specific circumstances. Third, the rule modified other provisions such as overall goal-setting, good faith efforts, transit vehicle manufacturers, and counting for trucking companies.

Congress enacted the Fixing America's Surface Transportation Act (FAST-ACT) into Public Law 114-94 on December 4, 2015. The Act reaffirmed participation by DBEs in federally assisted contracts. The US DOT observed no difference in FAST-ACT compared to the last DBE law MAP-21.

NCHRP published current practices to set and monitor DBE goals on design-build projects and other alternative project delivery methods (Keen et al., 2015). Keen et al. found that the traditional DBE contract goal approach was unsatisfactory to agencies, contractors, and DBEs. Most states proposed new approaches that required the responsible design-builder to establish DBE goals when most of the design was complete.

Shrestha et al. (2015) compared the performance and impediments of DBEs, providing construction and professional services in transportation. Shrestha et al. collected 259 survey responses from DBEs nationwide to assess DBE factors in five categories: performance, internal impediments, external impediments, advantages, and disadvantages. Each category contained five to nine factors based on previous literature. Shrestha et al. calculated a relative importance index to compare these factors and performed binary logistic regression on survey data. Analyzed data distinguished the needs of DBEs in construction from DBEs in professional

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services. Significant impediments identified by construction DBEs were "expensive manpower," "lack of technology," "unskilled manpower," and "bid shopping." Construction DBEs needed financial assistance and safe work practices for improving business performance. However, DBEs providing professional services needed marketing assistance more than others did.

In summary, Congress revised DBE regulations and programs several times to increase program efficiency, flexibility, and accountability. These revisions reduced legal challenges, potential misunderstandings, and discrimination. Scholars studied various topics and found different, sometimes controversial, conclusions in different legal and regulation frames as well as contextual setting. Early studies reported that the DBE program increased construction costs on transportation projects. A later study showed minimum differences in cost estimates for a contract with or without a DBE goal. Under various reports and legal challenges, the set-aside, rigid, and minimum 10% DBE goal changed to an aspirational goal with both race-conscious and race-neutral measures. The DBE program became a useful tool to ensure fair competition on federally assisted contracts for all business enterprises.

Contemporary Overview of DBEs and DBE Programs

The US DOT distributes substantial federal funds to finance transportation projects initiated by state and local governments, public transit authorities, and airport entities every year (US DOT, 2016a). The US DOT manages the DBE program to comply with the Code of Federal Regulation Title 49, Part 23, and 26. The DOT has three operating administrations: Federal Highway Administration (FHWA), Federal Transit Administration (FTA), and Federal Aviation Administration (FAA). FHWA requires a separate DBE Supportive Services program to develop DBEs into viable, self-sufficient organizations, capable of competing for and performing on federally assisted highway projects.

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DBEs in the United States

Disadvantaged business enterprise (DBE) is a for-profit, small business; at least 51% owned by one or more both socially and economically disadvantaged individual(s), which often refer to either minorities or women. Although some scholars (e.g., Shrestha et al. 2016) assumed DBEs included both minority and woman business enterprises for simplicity, several theoretical distinctions exist among DBEs, minority business enterprises (MBEs), women business enterprises (WBEs), and small business enterprise (SBEs). Dang and Shane (2019) reviewed various programs used by DBEs for the diversity and inclusion of business enterprises. Many disadvantaged individuals started as a DBE and moved in a continuum of programs for each of the women, minority, or veteran-owned business enterprises. Figure 3 illustrates program distinctions with a rectangle representing SBEs, a circle representing DBEs, and two ellipses representing MBEs and WBEs, respectively.

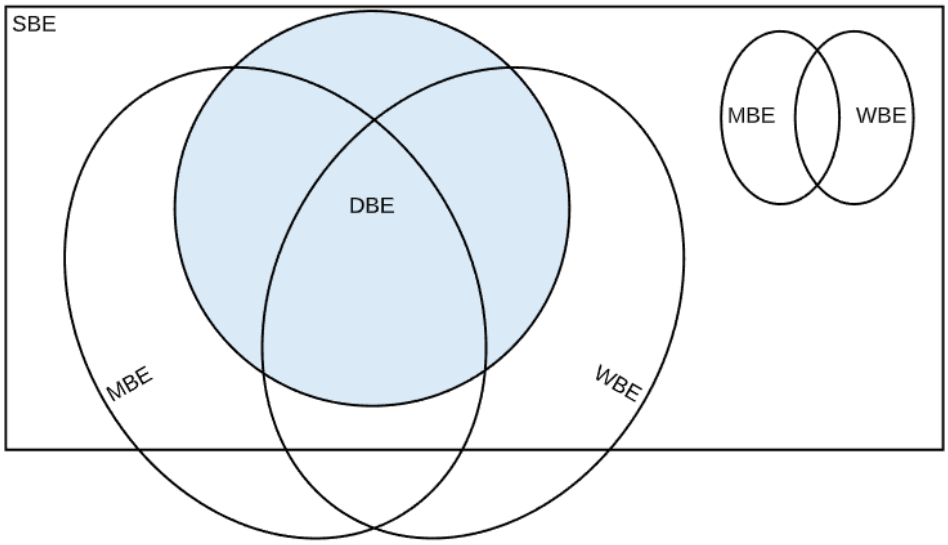

Figure 3. Theoretical Relations of DBE, MBE, WBE, and SBE.

The author counted 56,064 DBEs from 50 state DBE directories, 2,071 DBEs from District of Columbia, and 218 DBEs from Puerto Rico. One DBE might be certified in multiple

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states. Thus, the counted number had duplications, and the total number remained unknown. An approximate estimated number was 41,000 DBEs based on the national DBE directory maintained by FAA (Keen et al. 2019). Figure 4 shows the number of DBEs from each state DBE directory. The states with the most number of certified DBEs are Maryland, Texas, California, Georgia, Virginia, New York, Indiana, Illinois, and the District of Columbia. The number of certified DBEs are different compared to the number of ready, willing, and able (RWA) DBEs. Often, the DBE program encouraged small businesses owned by both socially and economically disadvantaged women and minorities to obtain DBE certifications and rely on general contractors to use DBEs as subcontractors in federally assisted projects. Since general contractors have no mechanism to identify DBEs that are ready, willing, and able to perform work meeting specifications, general contractors often stay with DBEs that they have worked with in the past and are reluctant to use a new and emerging DBE.

To further understand the DBE community, the author counted the total number of certified DBEs in 36 states and compared them with data in the NCHRP Synthesis 343. In the synthesis, the ready, willing, and able DBEs were ranging from 8% to 98% depending on 36 states based on the data collected in 2002. Comparing with the total number of certified DBEs in 2018, the number of certified DBEs increased, on average, 167% from the year 2002 to 2018 in these 36 states shown in Figure 5. Texas was the state with the highest increased number of certified DBEs. Missouri was the state with the highest increased percentage. Maine was the state with the lowest increased number of certified DBEs. Pennsylvania was the state with the lowest increased percentage. All 36 states had increased numbers of certified DBEs.

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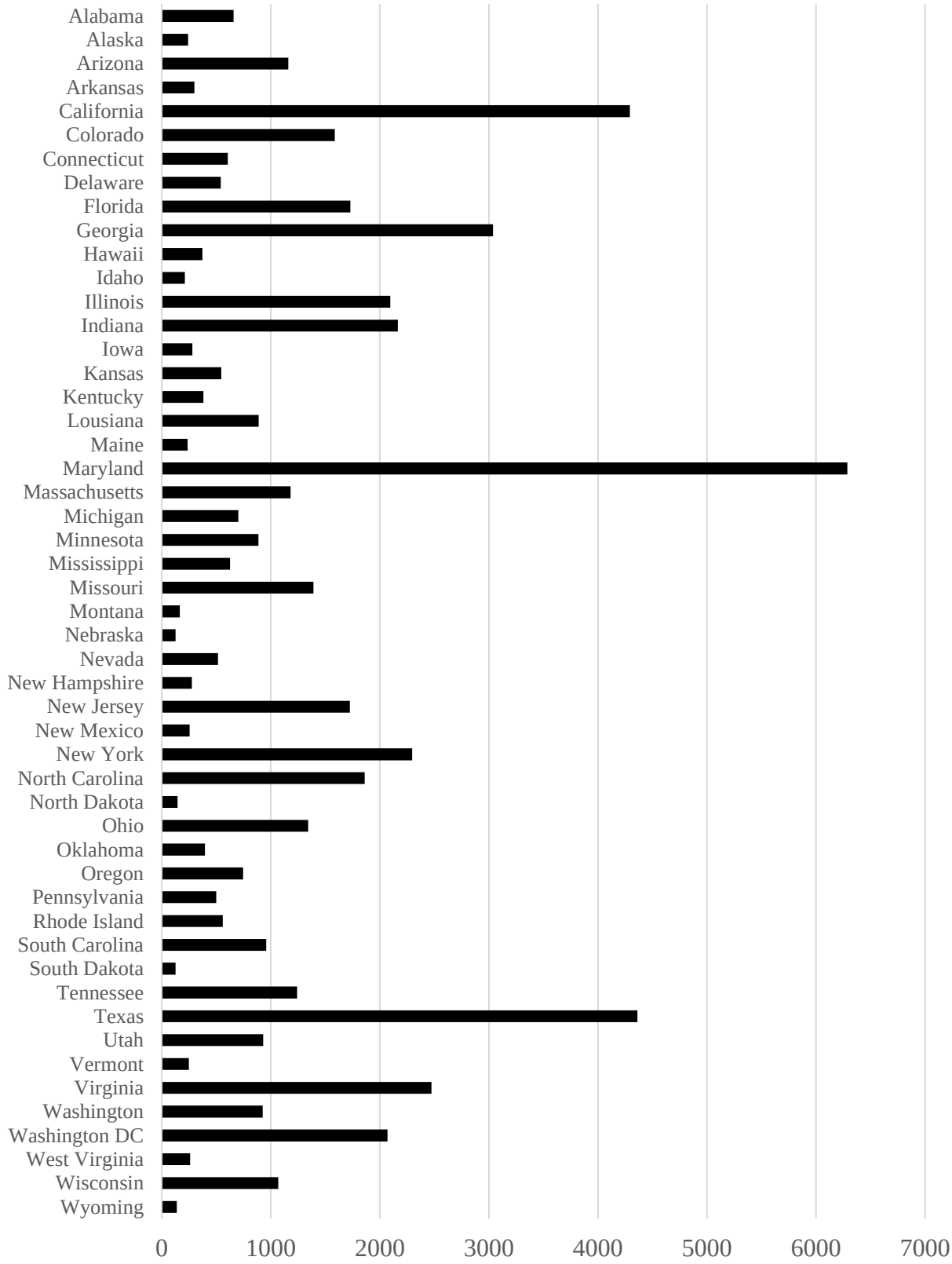

Figure 4. Numbers of Certified DBEs in 50 States and Washington as of 2018

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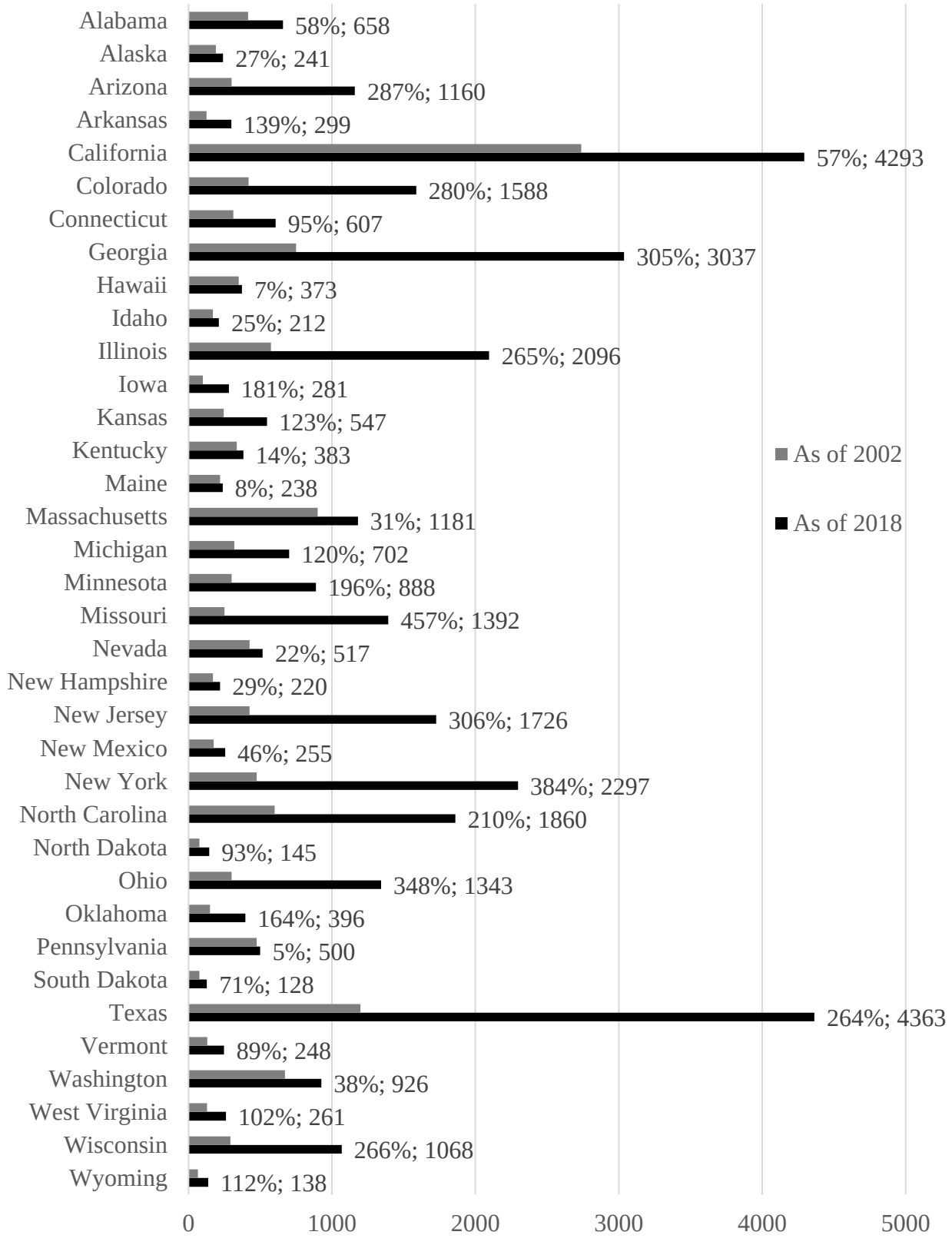

Figure 5. Comparison of Certified DBEs in 36 States as of 2002 and 2018

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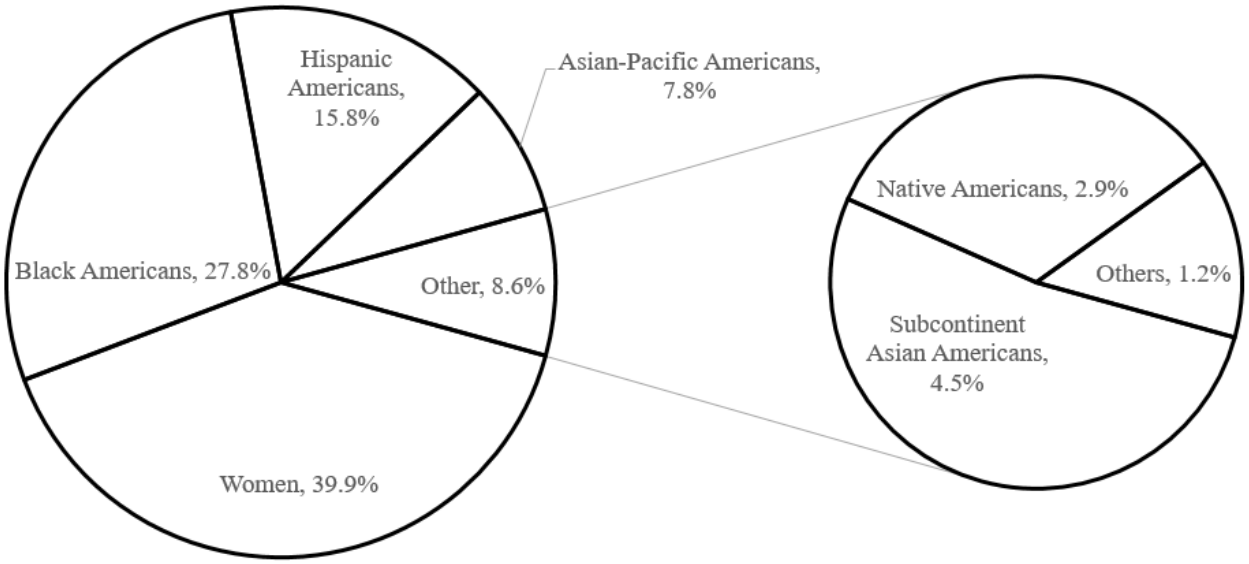
The DBE regulation defined seven socially and economically disadvantaged groups, including Black, Hispanic, Native, Asian-Pacific, Subcontinent Asian Americans, and women, as well as any others designated by the Small Business Administration. The author counted these disadvantaged groups in 16 states and illustrated the distribution in Figure 6. The largest group is women, followed by Black, Hispanic, Asian-Pacific, Subcontinent Asian, and Native Americans. The groups of women and Black Americans were relatively large, and each represents about a third of the total. The remaining third were mainly Hispanic and Asian Americans, with only 2.9% Native Americans and 1.2% of others. Although the combined data from 16 states depicted an overall distribution of disadvantaged groups, the actual distribution in each state was different. For example, Louisiana and Maryland had more than 50% of Black Americans in a DBE program. Oregon, Iowa, Minnesota, and Nevada had approximately 50% of women in a DBE program. Hawaii had 36% of Asian-Pacific Americans and 16% of Native Americans in a DBE program.



Note: Analyzed data are from states including Arkansas, California, Colorado, Florida, Hawaii, Iowa, Lousiana, Maine, Maryland, Minnesota, Neveda, Ohio, Oregon, Vermont, Washington, and Wisconsin.

Figure 6. Proportion of Disadvantaged Groups in Certified DBEs from 16 States

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The top 20 NAICS codes of certified DBEs are listed in Table 1. The author counted NAICS codes in 16 states and ranked them from the most to the least counted NAICS codes. The weighted percentage is the counted NAICS codes versus the total number of counted NAICS codes. The data indicated services in two major industrial sectors: sector 23 construction and sector 54 professional, scientific, and technical services. Another industrial service was subsector 484 truck transportation, specifically services "providing local, specialized trucking." The next 10 NAICS codes consisted of seven industries in sector 54, two industries in sector 23, and one specific industry providing landscaping services.

Table 1. Top 20 NAICS Codes from 16 States

NAICS Code	Count	Percentage	Description
541611	2287	4.38%	Administrative Management and General Management Consulting Services
541330	1981	3.79%	Engineering Services
237310	1820	3.48%	Highway, Street, and Bridge Construction
484220	1351	2.59%	Specialized Freight (except Used Goods) Trucking, Local
541618	1295	2.48%	Other Management Consulting Services
238910	1191	2.28%	Site Preparation Contractors
238990	1146	2.19%	All Other Specialty Trade Contractors
541512	1027	1.97%	Computer System Design Services
236220	1012	1.94%	Commercial and Institutional Building Construction
541620	979	1.87%	Environmental Consulting Services
541690	902	1.73%	Other Specific and Technical Consulting Services
541511	844	1.62%	Custom Computer Programming Services
541613	762	1.46%	Marketing Consulting Services
238210	671	1.28%	Electrical Contractors and Other Wiring Installation Contractors
237990	656	1.26%	Other Heavy and Civil Engineering Construction
541519	595	1.14%	Other Computer Related Services
541990	568	1.09%	All Other Professional, Scientific, and Technical Services
541614	540	1.03%	Process, Physical Distribution, and Logistic Consulting Services

16 States: Arkansas, California, Colorado, Florida, Georgia, Indiana, Iowa, Kentucky, Louisiana, Massachusetts, Minnesota, Ohio, Pennsylvania, Rhodes Island, South Dakota, and Wisconsin.

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Federal and State DBE Programs

The United States (US) Department of Transportation (DOT) established a Disadvantaged Business Enterprise (DBE) program to ensure fair competition on federally assisted contracts nationwide. Additionally, the Federal Highway Administration (FHWA) established a Disadvantaged Business Enterprise Supportive Service program to remove barriers and assist DBEs to develop their business outside of the DBE program. The DBE program has been a controversial and debatable topic with changing laws, regulations, and requirements in the last few decades. Congress has reauthorized the DBE program several times since its inception in 1983. The US DOT adjusted the DBE program under proper laws and regulations. Many scholarly researchers expressed opinions about different concerns and reported research findings on various topics. Relevant offices such as the Office of the General Inspector (OIG) and Government Accounting Office (GAO) issued reports regarding the DBE program.

The Department Office of Civil Rights is the lead office of the DBE program in collaboration with the Office of the General Counsel and Office of Small and Disadvantaged Business Utilization (US DOT OIG, 2013; US DOT, 2016). Figure 7 illustrates the oversight structure of the DBE program. The US DOT oversees DBE programs in each of the three major operating administrations (OAs), including the Federal Highway Administration, the Federal Transit Administration, and the Federal Aviation Administration. Each OA manages its DBE program under the Office of Civil Rights.

Similarly, most state DOTs and local agencies manage their DBE programs under the Office of Civil Rights. Some manage their DBE programs in a separate office or by a state agency separated from state DOTs. The 49 CFR, §26, prescribes participation by DBEs in DOT financial assistance programs. The 49 CFR, §23, mandates the participation of DBEs in airport

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concessions. DBE program is required in the following operating administrations (49 CFR §26 Subpart B).

1. All FHWA recipients receiving funds authorized by a statute to which this part applies;
2. FTA recipients that receive $250,000 or more in FTA planning, capital, and/or operating assistance in a Federal fiscal year;
3. FAA recipients that receive a grant of $250,000 or more for airport planning or development.

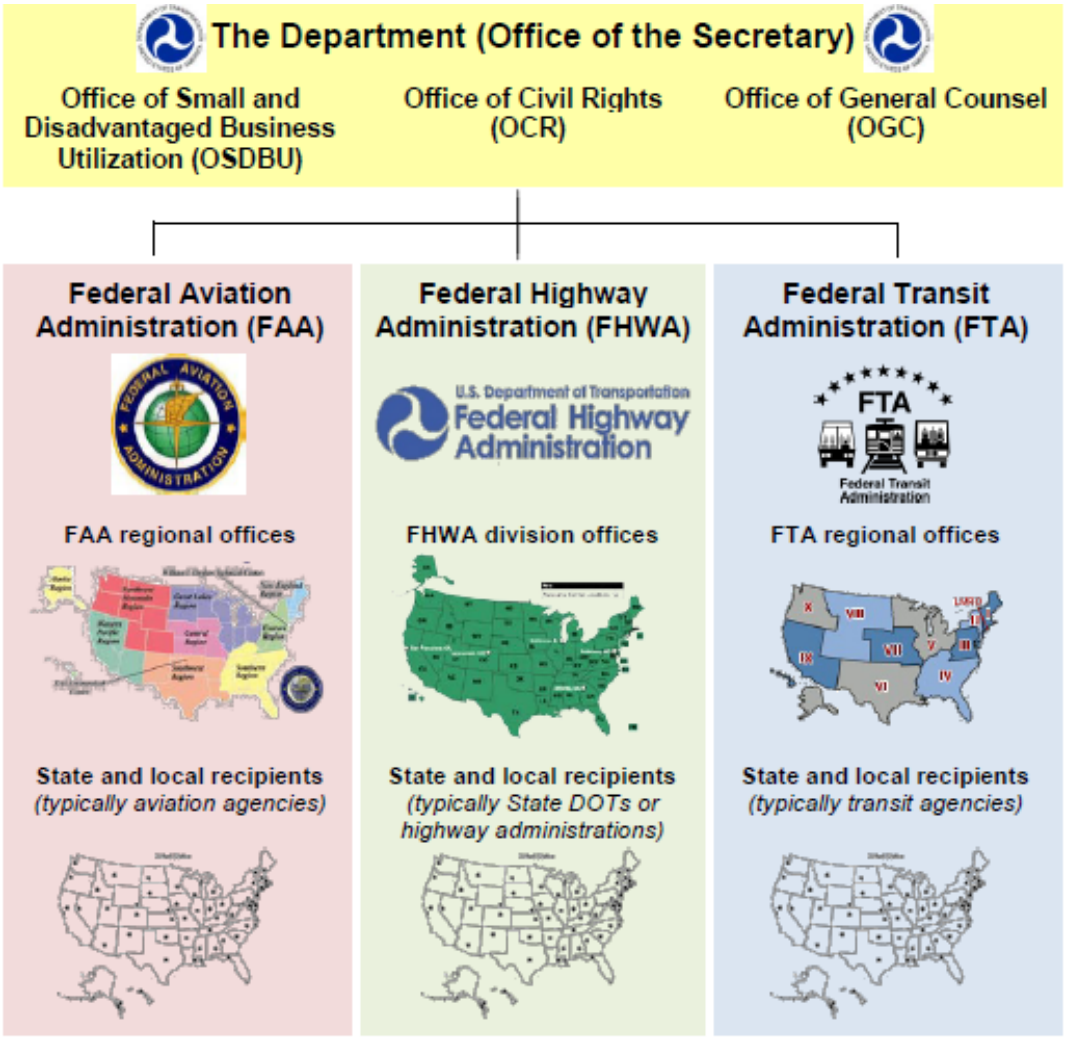

Figure 7. DBE Program Oversight Structure (US DOT OIG, 2013)

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The Code of Federal Regulations (CFR), Title 49, Part 26, describes eight objectives below for DOT DBE programs.

a) *"To ensure nondiscrimination in the award and administration of DOT-assisted contracts in the Department's highway, transit, and airport financial assistance programs;*
b) *To create a level playing field on which DBEs can compete fairly for DOT-assisted contracts;*
c) *To ensure that the Department's DBE program is narrowly tailored in accordance with applicable law;*
d) *To ensure that only firms that fully meet this part's eligibility standards are permitted to participate as DBEs;*
e) *To help remove barriers to the participation of DBEs in DOT-assisted contracts;*
f) *To promote the use of DBEs in all types of federally-assisted contracts and procurement activities conducted by recipients;*
g) *To assist the development of firms that can compete successfully in the marketplace outside the DBE program; and*
h) *To provide appropriate flexibility to recipients of federal financial assistance in establishing and providing opportunities for DBEs"* (64 FR5126, Feb. 2, 1999, as amended at 79 FR 59592. Oct. 2, 2014)

The DBE program defines a DBE as a for-profit, small business that is at least 51% owned and controlled by one or more both socially and economically disadvantaged individuals, including both citizens and lawfully admitted permanent residents of the United States. These individuals face conscious and unconscious discrimination, bias, racial, or ethnic prejudice

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beyond the individual's control in American society. There are seven presumably disadvantaged groups below (49 CFR §26):

1. *"Black Americans," which includes persons having origins in any of the Black racial groups of Africa;*
2. *"Hispanic Americans," which includes persons of Mexican, Puerto Rican, Cuban, Dominican, Central or South American, or other Spanish or Portuguese culture or origin, regardless of race;*
3. *"Native Americans," which includes persons who are enrolled members of a federally or State recognized Indian tribe, Alaska Natives, or Native Hawaiians;*
4. *"Asian-Pacific Americans," which includes persons whose origins are from Japan, China, Taiwan, Korea, Burma (Myanmar), Vietnam, Laos, Cambodia (Kampuchea), Thailand, Malaysia, Indonesia, the Philippines, Brunei, Samoa, Guam, the U.S. Trust Territories of the Pacific Islands (Republic of Palau), Republic of the Northern Marianas Islands, Samoa, Macao, Fiji, Tonga, Kiribati, Tuvalu, Nauru, Federated States of Micronesia, or Hong Kong;*
5. *"Subcontinent Asian Americans," which includes persons whose origins are from India, Pakistan, Bangladesh, Bhutan, the Maldives Islands, Nepal or Sri Lanka;*
6. *Women;*
7. *Any additional groups whose members are designated as socially and economically disadvantaged by the SBA, at such time as the SBA designation becomes effective.* [64 FR 5126, Feb. 2, 1999, as amended at 64 FR 34570, June 28, 1999; 68 FR 35553, June 16, 2003; 76 FR 5096, Jan. 28, 2011; 79 FR 59592, Oct. 2, 2014]

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CHAPTER 3. RESEARCH METHODOLOGY

Chapter 3 describes philosophical worldview, interdisciplinary approach, methodology and methods, research design, and validity and trustworthiness. These descriptions reflect the author's epistemological stance, positionality, and reflexivity in qualitative research. Additionally, the author explains the overall research design of interdisciplinary studies for the success of DBEs in the transportation sector.

Introduction

This dissertation consists of three interdisciplinary studies focusing on characteristics of DBEs and practices of DBE programs, DBE challenges, effective supportive services, and common DBE fraud schemes. Below are the research questions for each study:

1. What are the characteristics of DBEs and practices of DBE programs?
    a. What are the characteristics of DBEs in the United States?
    b. What are the practices of DBE programs in the United States?
2. What are DBE challenges in the DBE program?
    a. What are the variable clusters of DBE challenges?
    b. What are the principal components of DBE challenges?
3. What are useful supportive services for DBEs?
    a. What are useful support services and adult learning practices?
    b. What framework can be developed to provide useful supportive services?
4. What are the common DBE fraud schemes?
    a. What are statically evidence of DBE fraud and abuse?
    b. What are common DBE fraud and abuse schemes?

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Philosophical Worldview

The author reviewed four philosophical worldviews: positivism, constructivism, participatory, and pragmatism (Creswell, 2010). Positivism, also known as post-positivism, is about determination and theory verification through reductionism and empirical observation and measurement. Constructivism, also known as interpretivism, is about understanding and theory generation through multiple participant meanings and social and historical construction. Participatory, also known as advocacy, is about change-oriented empowerment and issue-oriented political and societal issues. Pragmatism is about problem-centered, real-world practice-oriented, pluralistic, and consequences of actions.

Epistemological stance

The epistemological stance is a pragmatic viewpoint for mix methods, but a constructivist viewpoint for qualitative research. Rockmore (2005) approached epistemology as "the problem of knowing a mind-independent external world as it is" (p. 25). Lee (2012) states, "Epistemology is a theory of knowledge that explores the relationship between the inquirer and the knowable, or between the knower and the respondent." A subjectivist epistemology is the knower and respondent co-creating understandings. To co-create understandings implies some interaction between the inquirer and the knowable.

Pragmatic worldview aligns with a mixed-methods approach (Creswell, 2009), collecting both qualitative and quantitative data. Pragmatists believe "truth is what works at the time" in social, historical, political, and other contexts. They do not see the world as an absolute unity and do not commit to any one system of philosophy and reality. Pragmatists use multiple methods with an intended design for specific research outcomes.

A constructivist worldview is common in qualitative research. Researchers establish the meaning of a phenomenon from the view of participants. When participants seek an

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understanding of the work with the subjective meanings of their experience, they develop meanings toward certain objects or things. These meanings collectively form complex views on a specific topic, resulting in an inductive development of a theory. Baxter and Jack (2008) explained, “Constructivists claim that truth is relative and that it is dependent on one’s perspective. This paradigm recognizes the importance of the subjective human creation of meaning but does not reject outright some notion of objectivity”.

Positionality and reflexivity

Positionality and reflexivity statement increases the trustworthiness and credibility of qualitative research (Merriam & Tisdell, 2016). The statement describes the background and experiences of the researcher as well as identifies preparation to conduct the research and potential bias in the research process.

I identify myself as an international student from China who holds culture and philosophy from both eastern (i.e., China) and western (i.e., United States of America) countries. If desired to stay in the US, I am a disadvantaged individual. I am eligible to be a certified disadvantaged business enterprise and have the potential to establish and manage, such as business in civil engineering consulting and construction contracting industries. As an international student, I may have both cultural and language barriers to conducting qualitative research. However, the author is fluent in English and has lived in the US for about ten years. The author minimizes or removes barriers in research by embracing the culture and earning Bachelor of Science and Master of Science degrees, along with professional work experience and scholar publications.

I prepared myself in research by taking courses in business management, engineering education, and leadership development. Also, I collaborated with others on DBE supportive services such as workshop training, networking, and one-on-one consultations. I attended

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numerous meetings with professors, professionals, non-DBE contractors, DBE program administrators, and DBE individuals. All of these experiences contributed to the quality and outcome of the research.

By revealing my positionality, I uncover potential unconscious bias I may have in the research. Research participants may be unwilling to share information with an Asian during an interview. Although I use telephone interviews, which avoid seeing or judging by color, I cannot guarantee any racial bias because of the accent and tone in voice over the phone. I strive to use fluent and close to native English during all interviews and conversations.

Interdisciplinary Approach

Interdisciplinary research, by definition, requires the researcher to learn other disciplines. The researcher brings knowledge from different disciplines to solve a complex problem. The section below introduces different disciplinary research and explain interdisciplinary research for DBEs.

Disciplinary Typology

The definition of a "discipline" and discussions of interdisciplinary, intradisciplinary, multidisciplinary, crossdisciplinary, and transdisciplinary research attracted many scholarly debates. Many had slightly different definitions in their research. Stember (1991) provided an overview of different disciplinary typology and described them with clear distinctions. The author summarized these distinctive descriptions in Table 2.

Table 2. Descriptions of Different Disciplinary Research

Typology	Description
Intradisciplinary	Working within a single discipline
Crossdisciplinary	Viewing one discipline from the perspective of another
Multidisciplinary	Drawing on each disciplinary knowledge
Interdisciplinary	Integrating knowledge and methods from different disciplines
Transdisciplinary	Creating unity of intellectual framework beyond disciplinary perspectives

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To further illustrate the description in Table 2, the author created Figure 8 to show the relations of research, discipline, and researcher in different disciplinary approaches, represented by the star, the circle, and the researcher A, B, and C, respectively.

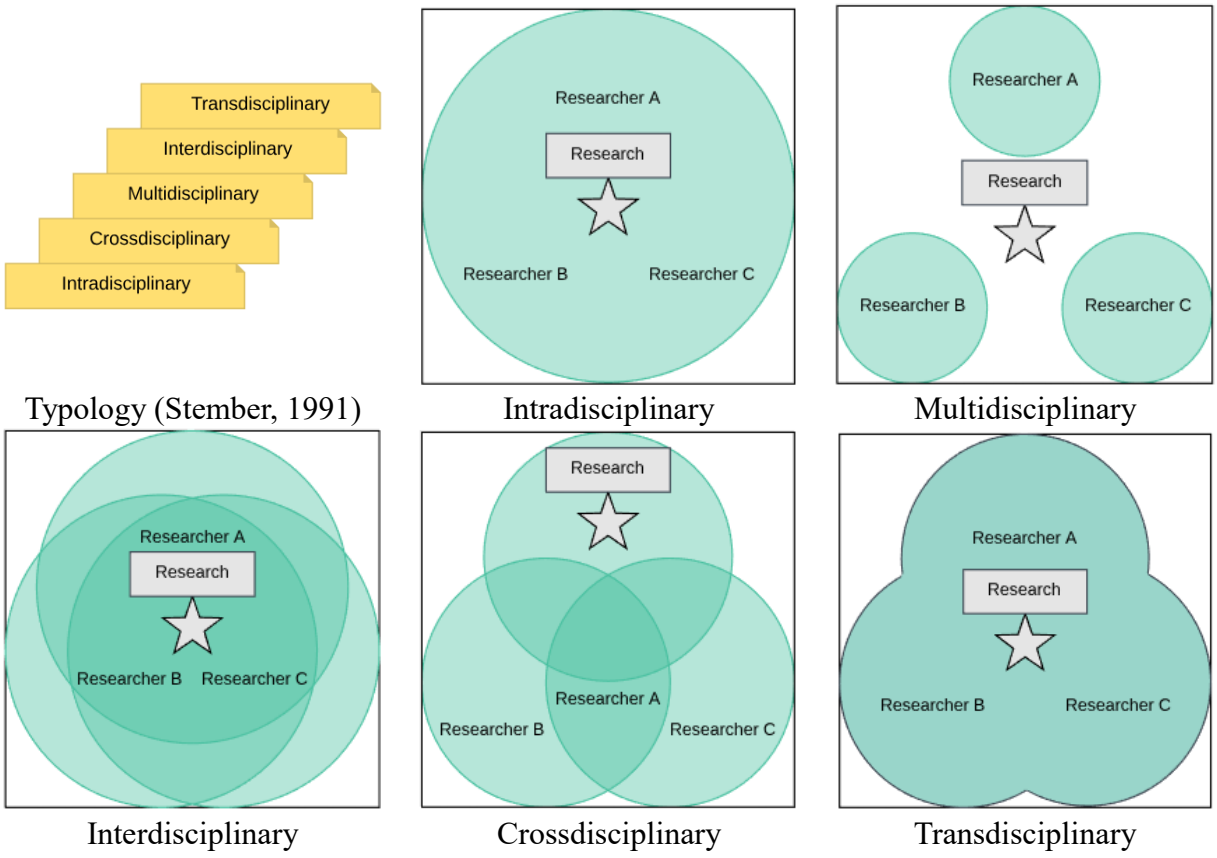

Figure 8. Typology within and across Disciplines in Research

Intradisciplinary research is the conventional research where researchers are researching inside their discipline. Research typically involves no disciplinary conflicts. Definitions are often clear and reliable in the discipline. Researchers must resolve disciplinary conflicts with proper conceptual and operational definitions for multidisciplinary, interdisciplinary, crossdisciplinary, and transdisciplinary research. Multidisciplinary research requires collaboration from different disciplines. Researchers contribute to the research from each discipline without overlapping disciplines. The research topic is typically outside of the researchers' disciplines. Interdisciplinary research requires the researcher to learn and bring knowledge from multiple

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disciplines. Researchers contribute to the research with overlapping disciplines. The research topic is typically in the overlapping area of all disciplines. Crossdisciplinary research indicates the research is outside of all researcher's disciplines. Researchers are viewing research from the perspectives of other disciplines. Transdisciplinary research emerges as a new discipline that binds all disciplines together. Researchers emerge disciplines together in pursuit of the research.

Although there is not always agreement on these definitions, it is clear that areas of research are dynamic, continually emerging, melding, and transforming. A contemporary interdisciplinary study today might be considered as a disciplinary study tomorrow. As a working definition of interdisciplinary research, we refer to the definition outlined in a National Academies' report (National Academies, 2005; National Science Foundation, 2018).

> *Interdisciplinary research is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practices.*

Interdisciplinary

Research studies related to Disadvantaged Business Enterprise are inherently complex because of the political, social, cultural, and educational dimensions. Although all relevant disciplines were considered, the author focused on four main areas – business, management, engineering, and education – that are closely related to construction. Figure 9 is a sketch of the interdisciplinary theoretical and conceptual framework. The framework indicated a need for interdisciplinary awareness and knowledge in solving complex problems for DBEs.

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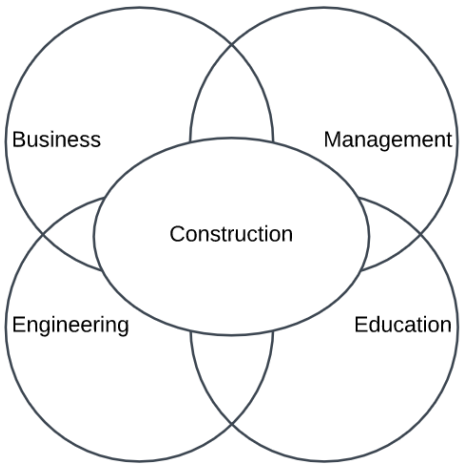

Figure 9. Interdisciplinary Theoretical and Conceptual Framework

Methodology and Methods

A methodology is the approach or process of research. A research methodology is a way to solve the research problem systematically. Research methods are tools used in research to collect data. Methods refer to techniques or procedures used to gather data in research. Because interdisciplinary research requires integration in methodology and methods, the author reviewed research methodology books in construction, education, social science, psychology, anthropology, clinical, business, marketing.

Construction engineering and management research rely on a variety of research methods. These methods mainly fall into three categories: quantitative, qualitative, and mixed methods. Figure 10 illustrates these research approaches and data collection methods. The procedures of mixed methods strategies are conveyed by notation and labels below.

- QUAL and QUAN capitalization indicate emphasis or priority on the quantitative or qualitative data, analysis, and interpretation in the study. In a mixed-methods study, the qualitative and quantitative data may be equally emphasized, or one may be more emphasized than the other. Capitalization indicates that an approach

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or method is emphasized. Lowercase indicates lesser priority or emphasis on the method.

- Quan and Qual stand for quantitative and qualitative, respectively, and they use the same number of letters to indicate equality between the forms of data.
- A plus sign "+" indicates a convergent or merging integration of data collection with both quantitative and qualitative data collected at the same time.
- An arrow "→" indicates a sequential form of data collection; one form (e.g., qualitative data) builds or connects with the other (e.g., quantitative data).
- Parentheses "()" indicate that one form of data collection is embedded within another or embedded within a larger design.
- Letter "T" stands for transformative research.

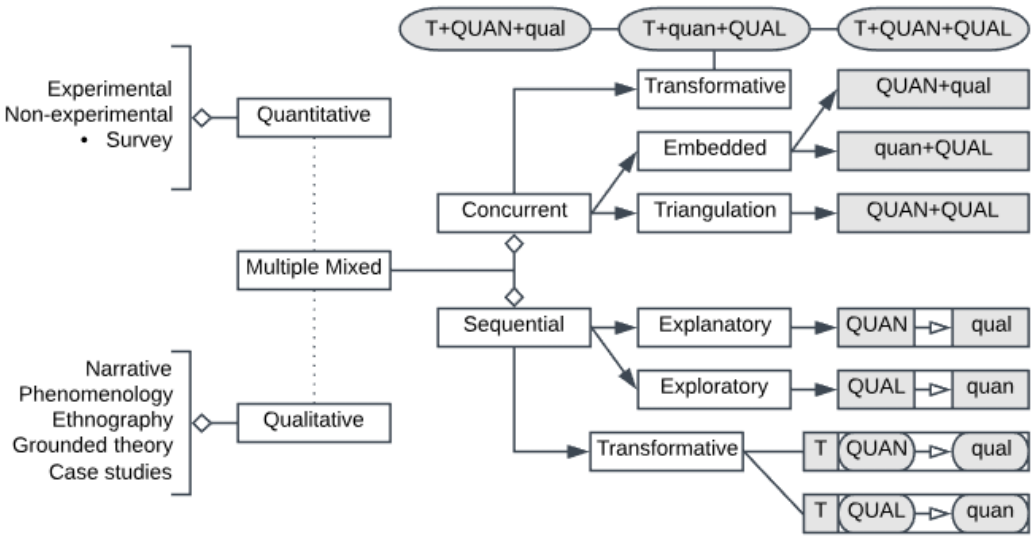

Figure 10. Quantitative, Qualitative, and Mixed Methods (Adapted from Creswell, 2013)

Quantitative or qualitative methods

Quantitative research is numerical and non-descriptive data using mathematics, especially statistics, to draw conclusive results. It investigates what, where, and when of decision-making.

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Results are often presented in tables and graphs. Quantitative approaches seek numerical data and facts, study relationships, and test theories based on mathematics or statistic models. Examples of quantitative research methods are surveys, experimental data, secondary data, historical data, and archival data.

Qualitative research is non-numerical and descriptive data using theories and facts to draw exploratory inferences and conclusions. It investigates the why and how of decision-making. Qualitative research approaches are useful in testing theory or research hypothesis that is lacking quantitative data. Qualitative approaches seek to understand perceptions from collective insights. Qualitative approaches provide in-depth perspectives through qualitative analysis. Qualitative research methods include, but are not limited to, content analysis, case studies, and interviews. Qualitative research extract information from an individual's interaction with the world around them (Merriam, 2002). Qualitative research has five common forms, including phenomenology, ethnography, grounded theory, narrative inquiry, and case study. Three major sources of qualitative data are interviews, observations, and documents.

Qualitative research refers to the philosophical foundation of positivism and constructivism in the natural context. The research seeks an interpretative understanding of complex things by using the researcher as a tool and asking new questions through personal reflection and interaction with the research object. Researchers use empathy, images, open interviews, case studies, participatory observations, and physical analysis to collective data. Descriptive data, using inductive research methods to obtain unique, regional knowledge, construct rooted and explanatory theories and present the standardized research methods of stories, events, processes, and meanings in the form of narrative texts. Quantitative and qualitative research have many distinctive aspects summarized in Table 3.

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Table 3. Comparison of Quantitative and Qualitative Methods

Research	Quantitative	Qualitative
Purpose	To understand & interpret social interactions	To test hypotheses, look at cause & effect, make predictions
Approach	Objective, focused, outcome-oriented	Subjective, holistic, process-oriented
Hypotheses	Specific, testable, stated before a particular study	Tentative, evolving, based on a particular study
Data Collection Strategies	Observations (non-participant). Interviews and Focus Group (semi-structured, formal). Administration of tests and questionnaires (close-ended)	Document and artifact (something observed). Interviews/Focus Groups (un-/structured, in-/formal). Administration of questionnaires (open-end). Taking of extensive, detailed field notes (participant, non-participant).
Research Setting	Controlled to the degree possible	Controlled setting not as important
Sample	Random: Intent to select "large," representative sample to generalize results to a population	Purposive: Intent to select "small," not necessarily representative, the sample to get an in-depth understanding
Measurement	Standardized, numerical (measurements, numbers), at the end	Non-standardized, narrative (written word), ongoing
Design and Method	Structured, inflexible, specified in detail in advance of study intervention, manipulation, and control descriptive correlation causal-comparative experimental consider few variables, large group	Flexible, specified only in general terms in advance of study non-intervention, minimal disturbance all descriptive - History, Biography, Ethnography, Phenomenology, Grounded Theory, Case Study, (hybrids of these) Consider many variables, small group
Variables	Specific variables studied	Study of the whole, not variables
Data Analysis	Raw data are numbers performed at the end of the study, involves statistics (using numbers to come to conclusions)	Raw data are in words. Essentially ongoing involves using the observations/comments to come to a conclusion
Role of the Researcher	Researcher & their biases are not known to participants in the study, and participant characteristics are deliberately hidden from the researcher (double-blind studies)	Participants in the study may know the researcher & their biases, and the researcher may know participant characteristics.

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Mixed methods

Mixed methods research has become increasingly popular and may be considered a legitimate, stand-alone research design (Creswell, 2002 & 2003; Greene et al., 1989; Tashkkaori & Teddie, 1998 & 2003; Hanson et al., 2005). It may be defined as "the collection or analysis of both quantitative and qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process of research" (Creswell, Plano Clark, Gutmann, & Hanson, 2003, p.212). When both quantitative and qualitative data are included in a study, researchers may enrich their results in ways that one form of data does not allow (Brewer & Hunter, 1989; Tashakkori & Teddie, 1998). Using both forms of data, for example, allows researchers to generalize results from a sample to a population simultaneously and to gain a deeper understanding of the phenomenon of interest. It also allows researchers to test theoretical models and to modify them based on participant feedback. Results of precise, instrument-based measurements may be augmented by contextual, field-based information (Greene & Caracelli, 1997)

Surveys and interviews

A survey is a commonly used instrument for collecting data. A survey can collect qualitative data such as narrative and quantitative data such as numbers. The qualitative survey is useful for a non-experimental descriptive design that seeks to describe reality or collect information on attitudes and behaviors. The quantitative survey collects numerical ratings and uses statistical tests to find hidden correlations. The author uses surveys to collect quantitative data from DBEs.

Interviews, a commonly used tool of data collection, serve as the primary form of data collection (Yin, 2015) in qualitative research. Open-ended responses allow one to understand the

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world, as seen by the respondents (Patton, 2015). The purpose of gathering responses to open-ended questions is to enable the researcher to understand and capture the points of view from other people without pre-determining those points of view through a prior selection of questionnaire categories. A semi-structured approach also allows for increased flexibility as previously unrecognized topics may emerge as interviews are conducted. New topics of interest and nuance of responses may emerge while maintaining general topics of the interview.

Research Design

The research design consists of four studies shown in Figure 11. The author starts with research questions and literature reviews. Both serve as the contextual background for the subsequent studies. Chapter four is an overview of DBEs and DBE programs to uncover characteristics of DBEs and practices of DBE programs. The validation and illustration of DBE information are based on the triangulation of data sources from content analysis, qualitative interviews, and quantitative surveys. The results increase the author's understanding and establish premises for contemporary research investigations. Chapter five identifies DBE challenges through statistical analyses. Chapter six is a sequential explanatory study using mixed-methods. Chapter seven uses multiple methods to collect data on DBE fraud and abuse cases. Qualitative data collections are using interviews. Quantitative data collections are using surveys and existing databases. The author determines sampling strategies, data collection methods, and data analyses for each study in the following paragraphs of the research design section.

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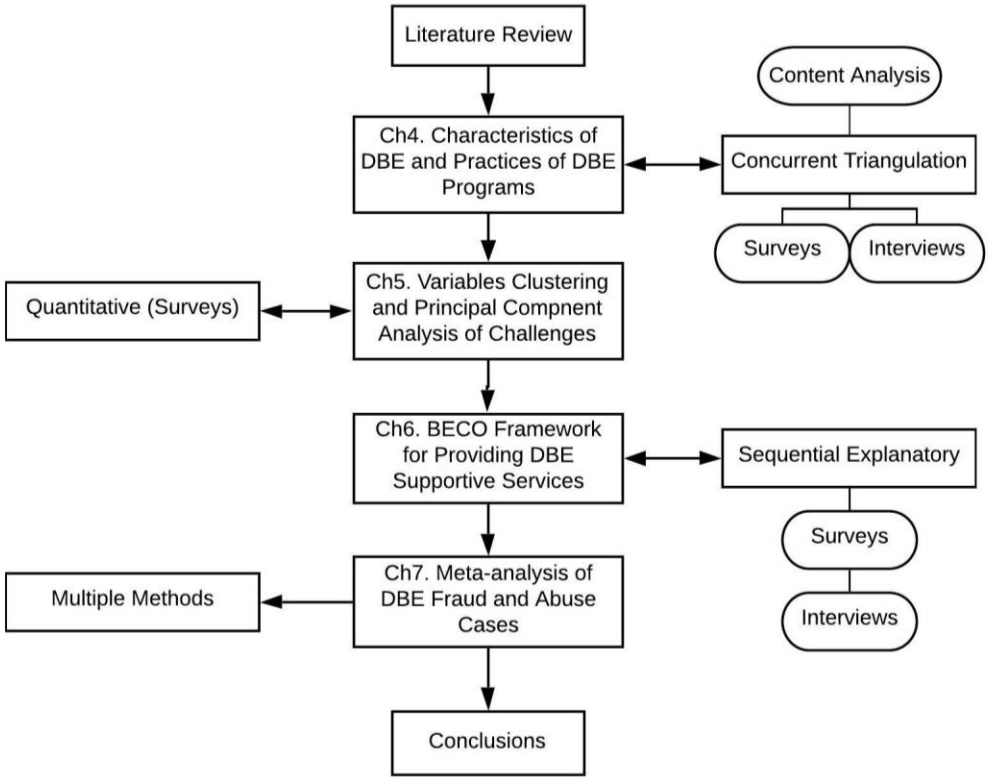

Figure 11. Overall Research Design

Sampling strategy

Sampling strategies include, but are not limited to, random, systematic, stratified, cluster, and multi-stage sampling strategies. The data collections are either purposefully sampling the top DBEs or randomly collecting information from all DBEs. The purposive sampling provides a deep understanding and rich contextual information through qualitative methods such as interviews, content analysis, and focus groups. The probability sampling produces an excellent representation. Table 4 provides the contrast of purposive and probability sampling strategies in three dimensions.

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Table 4. Comparison of Purposive and Probability Sampling Strategies

Dimension of Contrast	Purposive Sampling	Probability Sampling
Other Names	Purposeful sampling Nonprobability sampling Qualitative sampling	Scientific sampling Random sampling Quantitative sampling
Overall Purpose	Designed to generate a sample that will address research questions	Designed to generate a sample that will address research questions
Rationale for selecting	To address specific purposes related to research questions. The researcher selects cases she or he can learn the most from	The researchers

All survey data will use probability sampling. All interview data will use purposive sampling. Table 5 describes the purposive and probability sampling strategy for each study. The author purposefully selects successful DBEs who have been in business for a long time to collect qualitative data. This purposive sampling provides the most useful data. Survey data collection uses probability sampling. All DBEs are inclusive in the sample. However, only those who respond and participate in the survey will be the sample.

Table 5. Selections of Sampling Strategies for Each Study

Chapter	Purposive Sampling	Probability Sampling
Chapter 4	The first 20 largest DBE states	DBEs nationwide
Chapter 5	N.A.	DBEs nationwide
Chapter 6	1 or 2 successful DBE per state	DBEs nationwide
Chapter 7	Snowball Sampling	National Databases

Data collection

The data collection strategy depends on the question of the study. Collecting the best information to answer the question is critical in qualitative, quantitative, and mixed methods. Figure 12 illustrates the data collection workflow.

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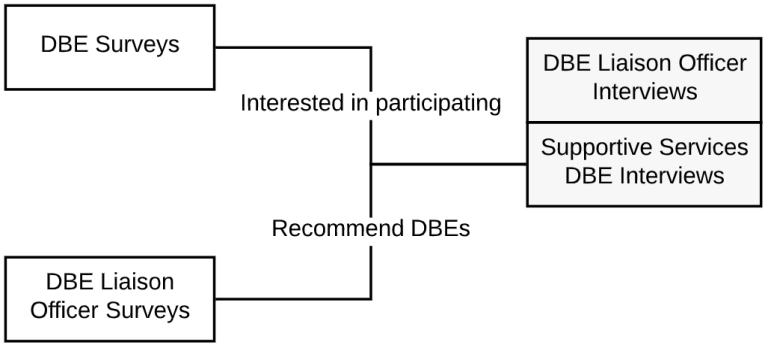

Figure 12. Data Collection Workflow

Data analysis

The author analyzes qualitative and quantitative data using different software and following different techniques and methods. Table 6 outlines these techniques and methods for each study. The following paragraphs explain the selected software and each technique or method in detail.

Table 6. Qualitative and Quantitative Data Analyses

Chapter	Quantitative Analysis	Qualitative Coding
Chapter 4	Descriptive Statistics	Descriptive Coding
Chapter 5	Variable Clustering Principal Component Analysis	N.A.
Chapter 6	Confirmatory Factor Analysis	Pattern Coding
Chapter 7	Descriptive Statistics	Content Analysis

Principle Component Analysis (PCA) extract the important information from a multivariate data table and to express this information as a set of few new variables called principal components. The PCA reduces the dimensionality of multivariate data to two or three principal components with minimal loss of information through data rotation. The factors influencing DBE and its programs are plenty and complex. PCA provides the opportunity to visualize data consisting of more than three variables without altering the native structure of the data.

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Confirmatory Factor Analysis (CFA) is a statistical technique used to verify the factor structure of a set of observed variables. The primary objective is to determine the ability of a predefined factor model to fit an observed set of data. CFA starts with a hypothesis about how many factors there are and which items load on which factors. Then CFA reveals the factor correlations through fit indices such as chi-square.

Quantitative data will be analyzed in R, free software for statistical computing and graphics. The software can perform multivariate data analysis, such as PCA and CFA. Qualitative data analysis will be conducted in the NVivo software package. NVivo is a qualitative research analysis software, which allows coding of common patterns and themes. The author will perform qualitative coding and ask for peer reviews and criticism. Merriam (2002) states, “data analysis is essentially an inductive strategy. One begins with a unit of data and compares it to another unit of data and so on, all the while looking for common patterns across the data. These patterns are given names (codes) and are refined and adjusted as the analysis proceeds”. A plethora of books recommended specific steps for qualitative analysis. The author will follow the six steps recommended by Creswell (2013) in the list below.

Step 1. Organize and prepare the data for analysis

Step 2. Read through all the data

Step 3. Begin detailed analysis with a coding process

Step 4. Use the coding process to generate a description of categories or themes

Step 5. Advance the description and representation of themes the qualitative narrative

Step 6. Interpret the data

The coding is the process of organizing and labeling data for interpretation and analysis. There is no "best" way to code and analyze qualitative data. The author can use multiple coding

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methods, and coding can be cyclic. The author adapts coding methods and terminologies from the book by Johnny Saldana named “The Coding Manual for Qualitative Researchers” in 2013. Each research study exploits at least a coding method from the book.

Descriptive coding assigns labels to data to summarize in a word or short phrase. The word or short phrase is often a noun representing the basic topic of a passage of qualitative data. This coding method is suitable for all qualitative studies, especially in social environments. Providing an inventory of topics for indexing and categorizing, this method is relatively easy for beginning qualitative researchers learning how to code data. The first study is about the description of the DBE and its programs. The author feels descriptive coding is appropriate for analyzing qualitative data for the first study.

Pattern coding identifies similarly coded data and organizes them into meaningful themes. This coding method is appropriate for developing major themes, searching for rules and causes, examining social networks and patterns of human relationships, or forming theoretical constructs and processes. The third study is explaining supportive services for DBEs. Pattern coding is appropriate for searching for the causes of different services.

Validity and Trustworthiness

Validity describes quantitative data, whereas trustworthiness describes qualitative data. Validity consists of four criteria: internal validity, external validity, reliability, and objectivity. Statistical tests provide validity for quantitative data. Concurrent triangulation is a unique approach to data validation for mixed methods. Merriam (2002) states that triangulation is where “the researcher collects data through a combination of interviews, observations, and document analysis.” The author used triangulation to validate DBE information from content analysis, qualitative interviews, and quantitative surveys.

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Trustworthiness consists of four criteria, including credibility, transferability, dependability, and confirmability in qualitative research. According to Merriam (2002), "in qualitative research, the understanding of reality is the researcher's interpretation of participants' interpretations or understandings of the phenomenon of interest." In addition to these four criteria, Lincoln and Guba (1989) suggested authenticity criteria, including fairness, ontological authenticity, educative authenticity, catalytic authenticity, and tactical authenticity. The author summarized ten criteria of trustworthiness for qualitative research in Table 7. The author follows these criteria throughout the research period.

Table 7. Ten Criteria of Trustworthiness for Qualitative Research

Criteria	**Description**
Credibility	Overall "believability", internal validity
Transferability	Generalizability, external validity
Dependability	Consistency, reliability
Confirmability	Neutrality of researcher
Authenticity	Truthful to participants
Coherence	The consistency of the research approach
Sampling adequacy	Appropriate sample size and composition for research purpose
Ethical validation	Engaging in research that informs practice
Substantive validation	Is the research "meaty" and worthwhile contribution?
Creativity	Novelty and flexibility in research design

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*Note: A list of selectively consulted books for research methods is at the end of the dissertation.

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CHAPTER 4. CHARACTERISTICS OF DISADVANTAGED BUSINESS ENTERPRISES IN STATE DEPARTMENT OF TRANSPORTATION DBE PROGRAMS

A paper to be submitted to the Journal of Construction Engineering and Management, published by the American Society of Civil Engineers (ASCE)

Abstract

The United States (US) Department of Transportation (DOT) established a Disadvantaged Business Enterprise (DBE) program to ensure nondiscrimination and fair competition on federally assisted contracts for all enterprises. DBEs are small businesses owned by women and minorities, presumably subjected to systemic oppression and sporadic discrimination, resulting in diminished opportunities in federal contracts. This study aims to uncover characteristics of DBEs in state DOT DBE programs through multiple methods such as content analysis, surveys, and interviews. Results, validated through concurrent triangulation, reveal that only a small portion of DBEs obtain contracting opportunities even though a large number of certified DBEs exist in each state. Many DBEs are small and struggle with disadvantaged status. Few DBEs are relatively successful but unable to graduate from or compete successfully outside of the program. The contributions of this research are (1) the description of the characteristics of DBEs, (2) the identification of unique challenges in DBE programs, and (3) the discussion of potential improvements serving as the foundation for future research. The outcomes of the research help understand DBEs and DBE programs, inform policymakers on future regulatory changes, and improve the experience of DBEs and the quality of DBE programs.

Introduction

The United States (US) Department of Transportation (DOT) established a program for minority business enterprises to ensure nondiscrimination and level the playing field in federal

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contracting in 1980. The US DOT renamed the program to the Disadvantaged Business Enterprise (DBE) program in 1983 under the Surface Transportation Assistance Act of 1982. The program raised many political debates and legal challenges in the following decades. Congress reauthorized the DBE program and revised the final rule several times. These changes included, but were not limited to, improving efficiency of the program, clarifying on various misleading topics, increasing accountability of recipients with relative flexibility, removing additional participation barriers, easing burdens on small businesses, adjusting personal net worth and business annual receipts for inflation, ensuring confidentiality of personal financial information, enforcing fraud and abuse detection and prevention, and reducing legal challenges. The most recent reauthorization was the Fixing America's Surface Transportation (FAST) Act (P.L. 114-94, Dec. 4, 2015), which allocated more than $350 billion to federal-aid highways from the fiscal years 2016 through 2020. The most recent DBE final rule became effective on November 3, 2014.

The Code of Federal Regulation Title 49 Part 26 (49 CFR §26) prescribes the program requirements for Federal Highway and Transit Administrations, and 49 CFR §23 prescribes the program requirements for Federal Aviation Administration. Each state DOT manages the DBE program under the appropriate supervision of federal agencies with the eight objectives stated in the 49 CFR §26 below. Similarly, Part 23 has six objectives, excluding the objectives (f) and (g).

(a) "To ensure nondiscrimination in the award and administration of DOT-assisted contracts in the Department's highway, transit, and airport financial assistance programs;

(b) To create a level playing field on which DBEs can compete fairly for DOT-assisted contracts;

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(c) To ensure that the Department's DBE program is narrowly tailored in accordance with applicable law;

(d) To ensure that only firms that fully meet this part's eligibility standards are permitted to participate as DBEs;

(e) To help remove barriers to the participation of DBEs in DOT-assisted contracts;

(f) To promote the use of DBEs in all types of federally-assisted contracts and procurement activities conducted by recipients;

(g) To assist the development of firms that can compete successfully in the marketplace outside the DBE program; and

(h) To provide appropriate flexibility to recipients of federal financial assistance in establishing and providing opportunities for DBEs" (64 FR5126, Feb. 2, 1999, as amended at 79 FR 59592. Oct. 2, 2014)

DBEs perform billions of dollars of construction work with a significant contribution to the economic development in the US (US DOT Office of Inspector General [OIG], 2013; FAST Act, 2015). However, most DBEs experience systemic oppression and sporadic discrimination, which creates barriers in the participation of federally assisted contracts and difficulties in doing and developing business. Although DBE programs promise a level playing field with various supportive services and assistance, the impact and effectiveness remain unclear at large. While some DBEs praise the program being helpful, others argue the program being useless or burdensome. To understand the fundamental reasons for these debatable claims, the author identified characteristics of DBEs and practices of DBE programs in this interdisciplinary research study. The research objectives are to address the following questions in the transportation sector.

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1. What are the characteristics of DBEs?
    a. Characteristics of DBEs providing engineering consulting services
    b. Characteristics of DBEs providing construction contracting services
2. What are the practices of DBE programs?
    a. Practices (core and unique functionalities) of DBE programs
    b. Practices (common or specific) of DBE supportive service programs

The research is limited and restricted to some specific topics due to the broad and complex nature of DBE research. Below are the topics that this research will not address.

- Disparity and Availability Studies
- Overall Goal-setting Methodologies
- Unified Certification Program (UCP)
- Commercially Useful Function (CUF)
- Prompt Pay Provision
- DBE Goals or Good Faith Effort in Contracts
- DBE Replacement or Termination on projects
- DBE Overconcentration in Work Types
- DBE Fraud or Legal Challenges
- DBE Goals in Innovative or Alternative Contracting Methods

A Disadvantaged Business Enterprise (DBE) is a for-profit, small business that is at least 51% owned and controlled by one or more both socially and economically disadvantaged individuals, including both citizens and lawfully admitted permanent residents of the United States. There are seven presumably disadvantaged groups (49 CFR §26): Black, Hispanic, Native, Asian-Pacific, Subcontinent Asian Americans, and women (i.e., white Caucasian) as well

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as any additional groups designated by the Small Business Administration (SBA). A Disadvantaged Business Enterprise Liaison Officer (DBELO) is responsible for implementing all aspects of the DBE program with adequate staff, support, and resources. The DBELO should have direct or independent access to DBEs. DBE programs use race-conscious, race-neutral, or mixed measures. Race-conscious measures or programs specifically focus on assisting only DBEs. Race-neutral measures or programs generally focus on assisting all small businesses regardless of race or gender. In contrast to DBEs, A non-disadvantaged business enterprise (NBE) is a business enterprise that is not a DBE. Often, an NBE is a business owned by a white man or any individual that is not socially or economically disadvantaged.

Literature review

Literature regarding DBEs widely spread across government audits and reports, legal cases and reviews, and scholar studies from a variety of disciplines such as transportation, construction engineering and management, political science, public administration, and economy. Previous studies have diverse topics such as DBE rules, programs, and supportive services in the last few decades. Some studies inequitably have biases and limitations. However, the overall understanding of DBE rules, programs, and supportive services have increased over time. For example, the National Cooperative Highway Research Program (NCHPR) has seven syntheses or reports published in the National Academies of Sciences, Engineering, and Medicine.

- In 2005, Synthesis 343 titled “Management of Disadvantaged Business Enterprise Issues in Construction Contracting.”
- In 2007, Web-Only Document 120 titled “A Survey of State Practices for Protecting Transportation Agencies against Construction and Disadvantaged

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Business Enterprise Fraud Including Use of Contractor Suspension and Debarment Procedures."

- In 2010, Report 644 titled "Guidelines for Conducting a Disparity and Availability Study for the Federal DBE Program."
- In 2011, Synthesis 416 titled "Implementing Race-Neutral Measures in State Disadvantaged Business Enterprise Programs."
- In 2013, Synthesis 448 titled "State Department of Transportation Small Business Programs."
- In 2015, Synthesis 481 titled "Current Practices to Set and Monitor DBE Goals on Design-Build Projects and Other Alternative Project Delivery Methods."
- In 2019, Report 913 titled "Compendium of Successful Practices, Strategies, and Resources in the U.S. DOT Disadvantaged Business Enterprise Program."

The NCHRP synthesis 343 uncovered administrative practices of the DBE program through survey responses collected from 36 state transportation agencies (STAs). The synthesis pointed out that the ready, willing, and able (RWA) DBEs were less than the certified DBEs in each state. The RWA DBEs were range from 8% to 98% depending on state based on the data as of 2002 in the NCHRP Synthesis 343. In a recent review of DBE commitment, even fewer DBEs actively bid and participated in federally assisted contracts. STAs used both administrative practices and supportive services to promote the use of DBEs. Some administrative practices were setting a DBE goal on individual contracts, unbundling large contracts, providing a list of bidders, paying promptly, and releasing retainage. Although a DBE contract goal was an effective way for DBE participation, the goal created a series of issues in contract administration. Some STAs use race-neutral measure more often than race-conscious measure, which the race-

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conscious measure set a DBE contract goal, but the race-neutral measure does not set a DBE contract goal at a project level. The NCHRP (2011) published race-neutral measures in DBE programs, including supportive services and training measures, administrative support strategies, marketing and outreach strategies, financial assistance strategies, and additional race-neutral strategies. This report identified that DBEs struggled with financial challenges, development issues, and lack of experience or equipment.

The Federal Highway Administration and Federal Transit Administration hosted a peer exchange for DBE and business development programs (BDP) in 2014. The BDP aimed to help certified DBE firms thrive in and do business competitively outside of the DBE program. The 49 CFR §26 Appendix C describes guidelines for the BDP. The BDP generally consists of two stages: a development stage and a transitional stage. The development stage requires a business plan with strategies for specific business targets, objectives, and goals. A DBE in this stage aims to achieve economic viability in workplaces outside the DBE program. In the transitional stage, the business plan should include "a transition management plan" for moving out of (i.e., graduating from) the DBE program.

Seven technical papers explicitly addressed DBE performance impediments (Kim and Arditi, 2010; Shrestha et al., 2015), DBE policies and issues (Koehn and Espaillat, 1984; Chang, 1989; Beliveau et al., 1991; and El-Itr and Kangari, 1994), and suggestions for increasing DBE participation (Change, 1987) in the American Society of Civil Engineering publication library. Only one study was published after the latest DBE regulation as of 2014. This study, conducted by Shrestha et al. (2015), surveyed 259 business enterprises to compare the performance of performance and impediments of construction and professional DBEs in transportation projects. Shrestha et al. (2015) reported that professional firms needed marketing, whereas construction

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firms needed financial assistance, safe work practices, technology support, and technical training.

Directory data

The author collected and illustrated the number of certified DBEs in 50 states and Washington on the US map in Figure 13. The bubble size represents the relative number of certified DBEs in a state or district. The largest is 6,288 in the state of Maryland, followed by Texas, California, Georgia, Virginia, and New York. The number of certified DBEs does not represent the availability of RWA DBEs. Data from the currently available directories do not contain information on RAW DBEs.

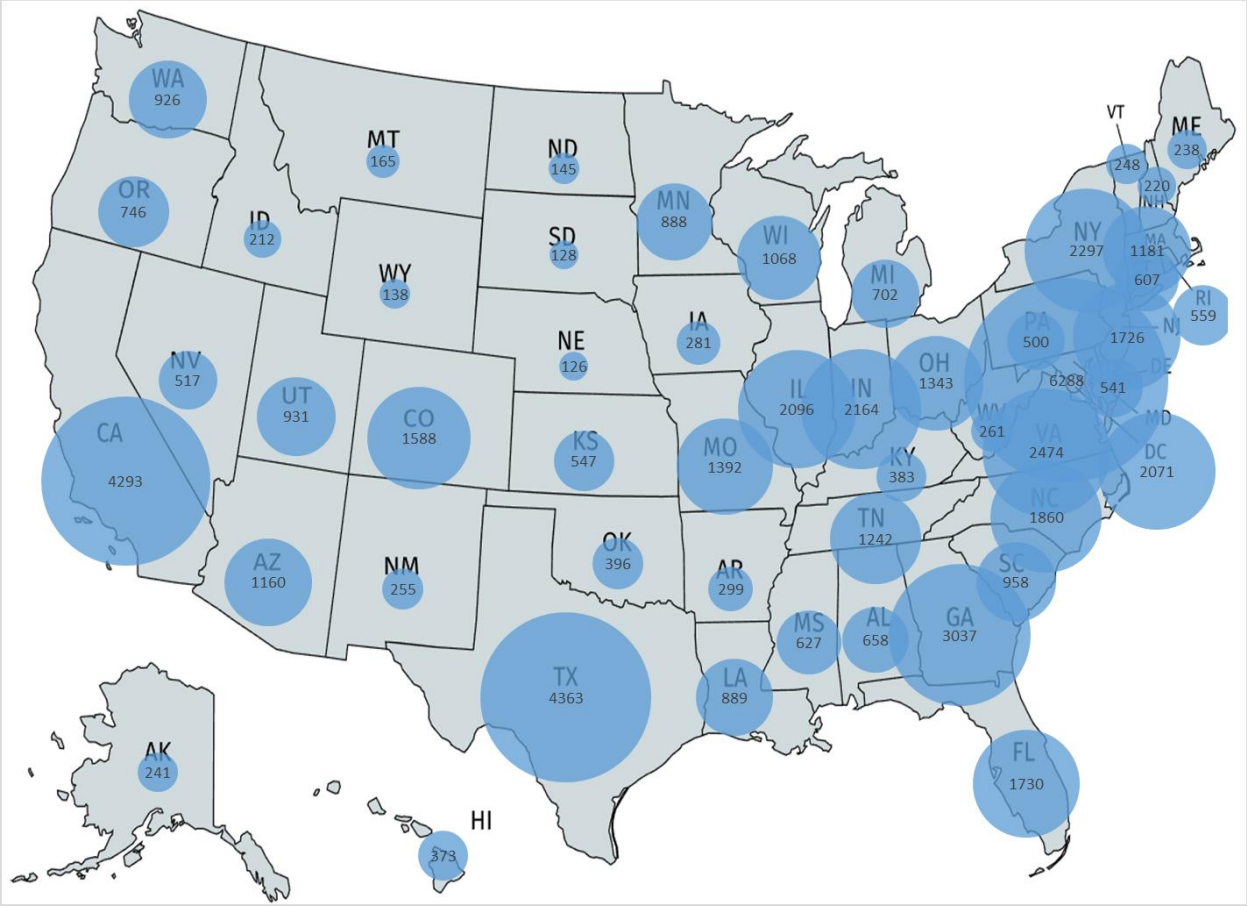

Figure 13. Certified DBEs in 50 States and Washington as of 2018.

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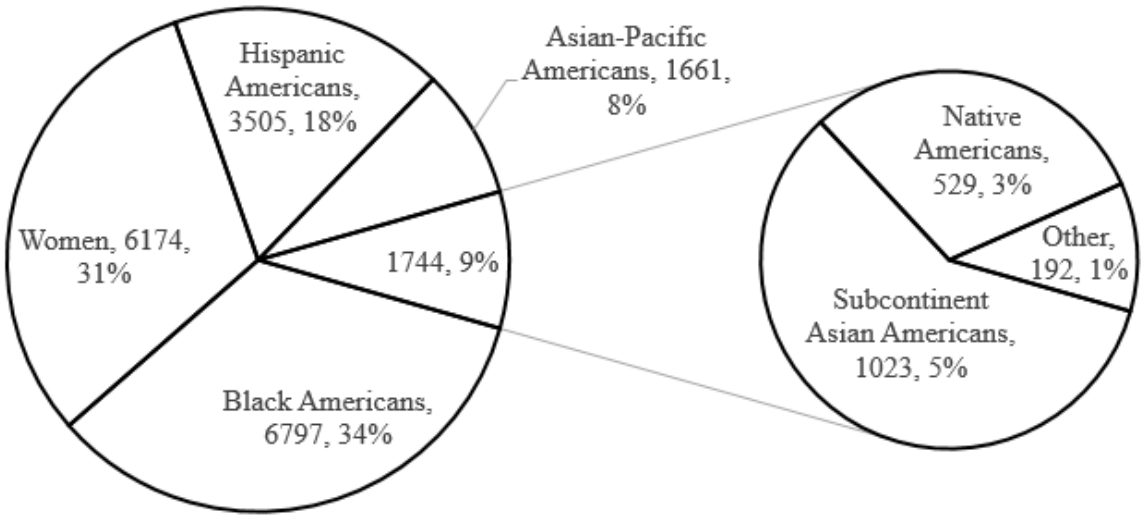
The DBE regulation defined seven socially and economically disadvantaged groups, including Black, Hispanic, Native, Asian-Pacific, Subcontinent Asian Americans, and women as well as any others designated by the Small Business Administration. The author counted these groups in 12 states and illustrated the distribution in Figure 14. The largest group is Black Americans, followed by Women, Hispanic Americans, Asian-Pacific Americans, Subcontinent Asian Americans, Native Americans, and others. The number of DBEs in the Black Americans and Women groups are approximately equally, and each represents about a third of the total DBEs. The remaining third is primarily Hispanic Americans and Asian Americans, with only 3% Native Americans and 1% of others. Although the combined data from 12 states depicts an overall distribution, the actual distribution is different in each state. Louisiana and Maryland have more than 50% of Black Americans in a DBE program. Oregon, Iowa, Minnesota, and Nevada have approximately 50% of women in a DBE program. Hawaii has 36% of Asian-Pacific Americans and 16% of Native Americans in the DBE program.



Note: Analyzed data from states including California, Colorado, Florida, Hawaii, Iowa, Lousiana, Maine, Maryland, Minnesota, Nevada, Oregon, and Wisconsin.

Figure 14. Proportion of Disadvantaged Groups in DBEs from 12 States

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DBEs register their businesses in the top 10 NAICS codes. The author counted NAICS codes in 16 states and ranked them from the most to the least counted NAICS codes in Table 8. The weighted percentage is the counted NAICS codes versus the total number of counted NAICS codes. The data indicates services in two major industrial sectors, including sector 23 construction and sector 54 professional, scientific, and technical services as the highest. Another widely identified industrial service is subsector 484, truck transportation, specifically services "providing local, specialized trucking." The next 10 NAICS codes consisted of seven industries in sector 54, two industries in sector 23, and one specific industry providing landscaping services.

Table 8. Top 10 NAICS Codes of DBEs from 16 States

NAICS Code	Count	Percentage	Description
541611	2287	4.38%	Administrative Management and General Management Consulting Services
541330	1981	3.79%	Engineering Services
237310	1820	3.48%	Highway, Street, and Bridge Construction
484220	1351	2.59%	Specialized Freight (except Used Goods) Trucking, Local
541618	1295	2.48%	Other Management Consulting Services
238910	1191	2.28%	Site Preparation Contractors
238990	1146	2.19%	All Other Specialty Trade Contractors
541512	1027	1.97%	Computer System Design Services
236220	1012	1.94%	Commercial and Institutional Building Construction

Note: Analysed data from Arkansas, California, Florida, Georgia, Indiana, Iowa, Kentucky, Massachusetts, Minnesota, Ohio, Pennsylvania, Rhodes Island, South Dakota, and Wisconsin

Research Methodology

Using a mix of qualitative and quantitative research, the author collected and analyzed data through multiple methods such as surveys, semi-structured interviews, content analysis, descriptive coding, and descriptive statistics. Figure 15 shows the research workflow.

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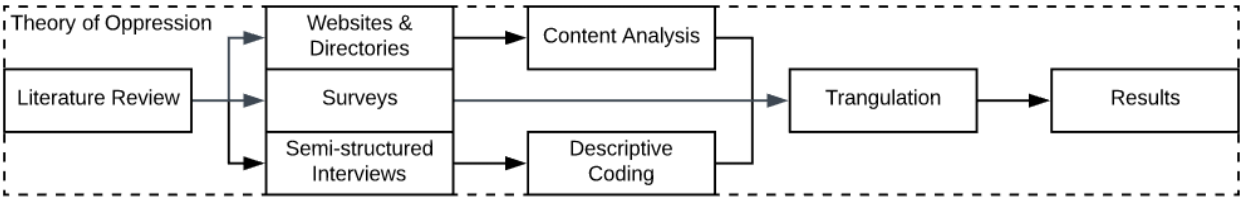

Figure 15. Research Workflow for DBE Firms and DBE Programs

Oppression is a conceptual theory that supports the critical understanding of DBEs and DBE programs. The definition of oppression is the unfair and cruel treatment by an influential person or government. For DBEs, the root cause of oppression is from slavery, racial segregation (i.e., Jim Crow Law), and gender discrimination. Because oppression is difficult to understand or identify, people often ignore or avoid oppression issues in developing legal systems and organizing society structures. Systemic oppression exists in various forms, such as racism, sexism, and classism resulting in inequality, privilege, and sometimes violence. Examples are the unjustly denied opportunity, discrimination in contracting, or barriers in doing business and participating in federally assisted contracts. Historically oppressed individuals are both socially and economically disadvantaged individuals. These individuals have unequal access to credit or capital in the business and unequal treatment in opportunities for government contracts by public officials, general contractors, potential customers, and business associates. They may be excluded from business or professional organizations because of their socially and economically disadvantaged status. Although both civil rights movements and affirmative actions have promoted nondiscrimination and equality, systemic oppression still prevents DBEs from fairly competing for federally assisted contracts, particularly racial and gender discrimination. Discrimination is an explicit form of oppression. In the case of *Adarand constructor, Inc. v. Norman Y. Mineta, Secretary of Transportation, et al. (2001),* the Court agreed with two effects of racial discrimination: entry-level discrimination and ongoing marketplace discrimination

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confronting established minority contractors. The five ongoing discriminations are (1) "Good-Old Boy" networks, (2) unequal access to bonding, (3) bidding shopping, (4) price discrimination by suppliers, and (5) unfair denial of opportunity to bid.

Multiple methods

The author used three methods for data collection: (1) DOT DBE websites and directories, (2) comprehensive surveys from DBEs, and (3) semi-structured interviews from DBELOs. DOT DBE websites and directories contain valuable information for understanding and analyzing national DBE data. However, information is inconsistent and sometimes inaccessible from state DOT DBE websites. The author collected directories from 50 states and Washington. Based on the CFR, the directory is required to include, at a minimum, the name, email, phone, address, and NAICS codes of certified DBEs. Some states included additional information such as ethnicity, gender, disadvantaged groups, and description of services. The author compiled names and emails for survey invitations. Then the author analyzed presumably disadvantaged groups and NACIS codes. The DOT DBE websites have various documents such as the DBE program plan, goal-setting methodology, certification checklist, and supportive services. The author explored this information and literature for developing the survey questions and semi-structured interview protocols. The author developed a comprehensive survey with various flows and skip-logics. The author conducted a cognitive interview on the survey with two individuals; one was a professor, and the other was a DBE owner. The survey has 26 main questions. Of the 26 questions, 23 questions are specifically for this study. Below is a breakdown of various questions in three sections

- Questions 1 to 8 are demographic information
- Questions 9 to 16 are business information

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- Questions 17 to 23 are specifics for DBEs and DBE programs

The author first obtained contact information from state DOT DBE program websites. All duplicates (e.g., DBE firms certified in multiple states) were removed, so a DBE would only get one request to complete the survey. The author sent the survey to 35,178 DBEs (i.e., unique by the email address and owner's name) and collected 1,384 responses between June and July of 2019. Although the response rate is low (i.e., approximately 3.4%), the number of responses is significant. The author used descriptive statistics for demographic and business information.

Along with developing the survey, the author constructed an interview protocol to collect qualitative data from DOT DBELOs. The protocol has three sections and 15 questions. These three sections are DBE characteristics, DBE program, and DBE supportive services program. The author conducted ten semi-structured interviews with state DOT DBELOs. The author recorded, transcribed, and coded all interviews. The author used descriptive coding for qualitative analysis to find common themes and patterns from interviews. Descriptive coding assigns labels to data to summarize key themes in words or short phrases. The phrase is often a noun describing the primary topic of a passage of qualitative data. These phrases provide an inventory of topics for indexing and categorizing.

Data representation

The survey responses are representative compared to the nationally certified DBEs. Figure 16 shows the number of survey responses from 50 states and Washington. The bubble size represents the number of survey responses. The bubble sizes are similar compared with Figure 13, which means each state has a percentage of certified DBEs that responded to the survey. The overall responses are proportional to the number of certified DBEs in 50 states and Washington. The DOT DBELOs from the orange shaded states participated in the semi-structured interviews. These states are Washington, Oregon, Arizona, Oklahoma, Minnesota,

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Louisiana, Tennessee, Ohio, North Carolina, and Maine. Because these states are geographically dispersed, the interview data collected from DBELOs are representative.

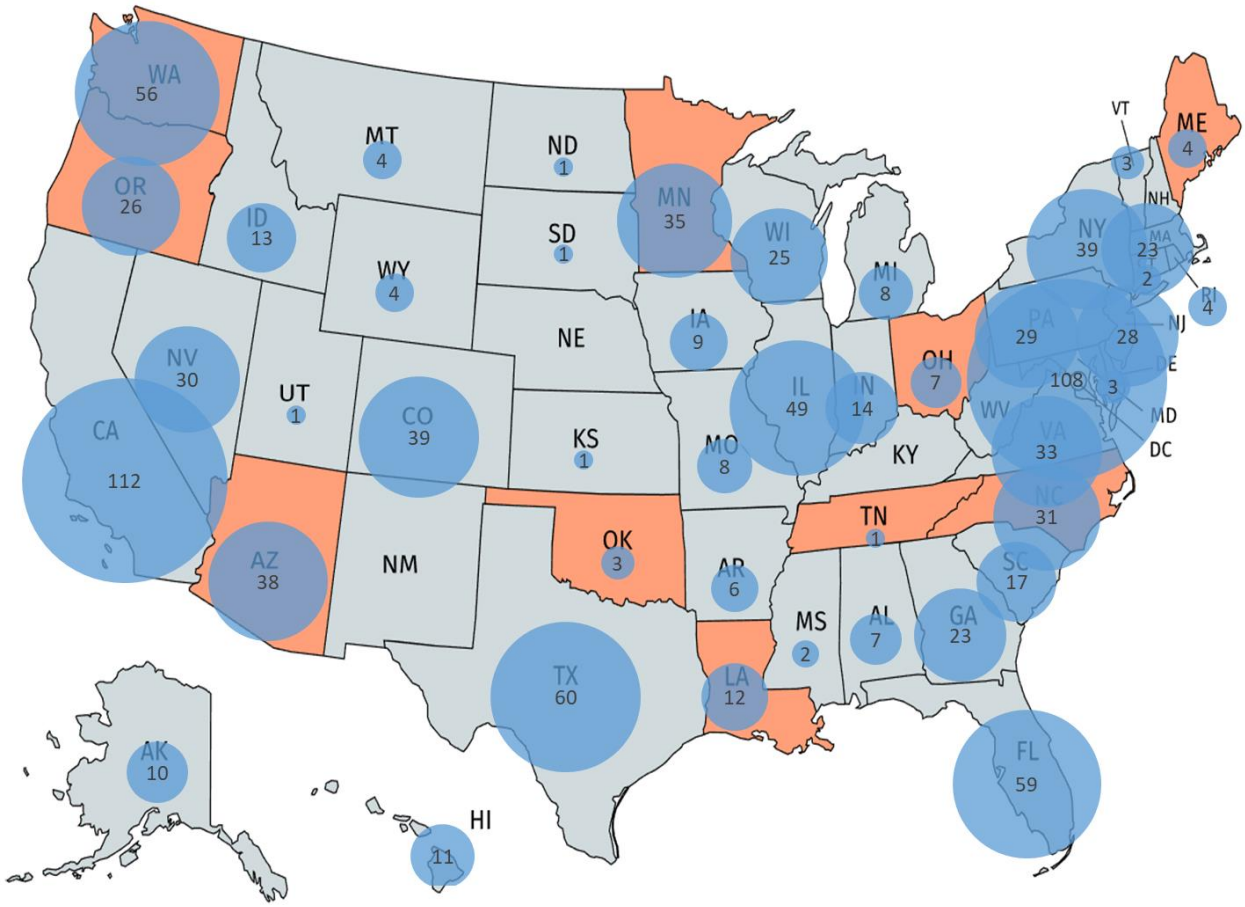

Figure 16. Numbers of DBE Survey Responses and DBELO Interviews from 10 States

The disadvantaged groups are representative compared to the available directory data. Figure 17 shows the ethnicity distribution of survey respondents from 12 states. Comparing with Figure 14, the white (i.e., Caucasian) women have relatively broad representation. However, the percentage of each group is similar. Thus, the data from survey respondents are genuinely representative compared to the certified DBEs nationwide. Because the collected data is representative, the descriptions and conclusions of the survey results represent the overall DBE characteristics.

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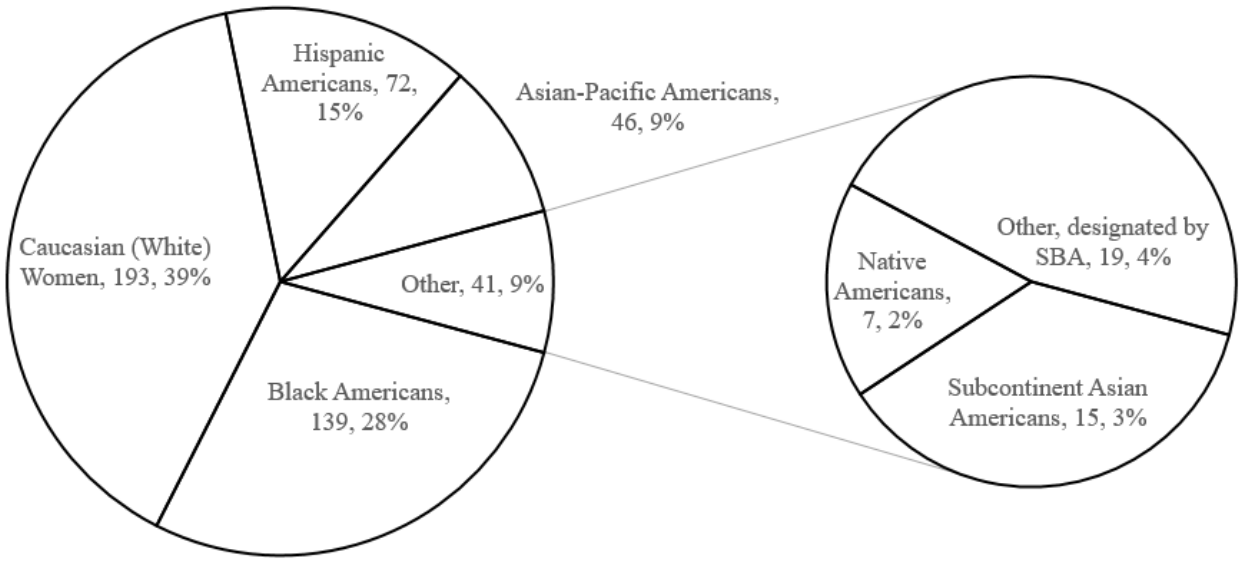

Figure 17. Ethnicity Distribution of Survey Respondents from 12 States

DBE Characteristics

Most people described DBEs with the words of small, disadvantaged, local, and emerging. The author examined DBEs from the perspectives of disadvantaged groups, education and experience, personal income, business revenue, and business area.

Overall certified DBEs

Certified DBEs have a large population and a diverse business portfolio. The survey respondents are 39% white (i.e., Caucasian) women, 30% of Black Americans, 15% of Hispanic Americans, 7% Asian-Pacific Americans, 4% of Subcontinent Asian Americans, 2% of Native Americans, and 3% other disadvantaged individuals designated by the SBA. Figure 18 shows the distribution of disadvantaged groups as well as the gender proportions from survey respondents. The total numbers of minorities, women, and both are 436, 454, and 267, respectively out of a total of 1,157 DBE responses.

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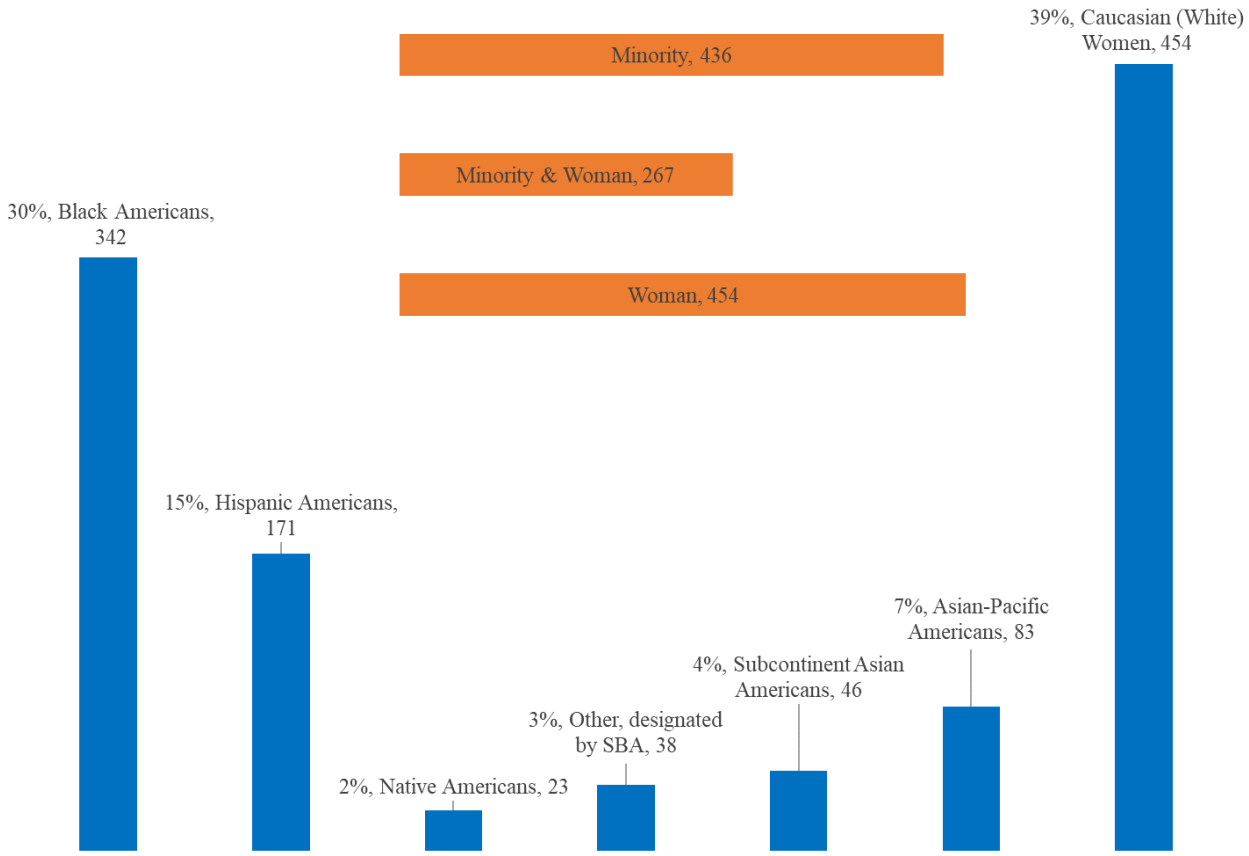

Figure 18. Distribution of Disadvantaged Groups from Survey Respondents

White women and Black Americans tend to be the dominant groups in most DBE programs. Some states have relatively equally represented groups. Rarely, Hispanic or Asian Americans are the dominant groups. Figure 19 shows the distribution of disadvantaged groups in 19 states. Only these states have ethnicity or gender data readily available from DBE directories. The sequence and order of the bar chart in Figure 19 are the same in Figure 18. The distributions show that the white woman (i.e., Caucasian) group dominates in the states of Washington, Oregon, Vermont, Maine, New Hampshire, Minnesota, and Iowa. The Black group dominates in the states of Maryland and Louisiana. Other states have equally dominant white women and Black Americans, usually followed by Hispanic and Asian Americans.

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Figure 19. Distribution of Disadvantaged (ethnicity or gender) Groups from 19 States

Approximately half of the certified DBEs are in either the engineering or construction industry based on survey responses. Although the DOT DBE program offers contracting opportunities closely aligned with engineering, constructing, and trucking industries, the other half of certified DBEs are in other business areas based on survey responses.

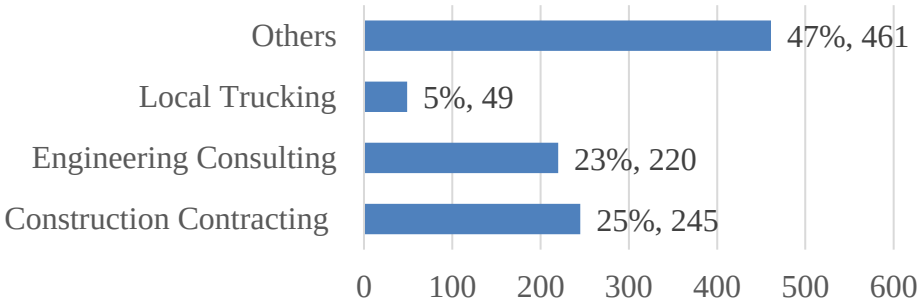

Figure 20. Business Areas that Best Describe DBEs from Survey Respondents

To further understand the business areas of DBEs, Figure 21 illustrates the word cloud of business description from survey respondents. The dominant categories are construction,

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management, engineering, planning, design, trucking, hauling, and development. Although a DBE may indicate construction services, DBEs are often subcontractors and perform special work that general contractors often subcontract to DBEs. DBEs rarely perform work that general contractors typically self-perform. Some DBEs are in IT-consulting, real estate, marketing, advertising, inspection, painting, and cleaning. The DOT contracting offices have fewer opportunities for these DBEs. A few certified DBEs provide supportive services to DBEs or conduct research related to DBEs or DBE programs.

Figure 21. Word Cloud of Business Description from Survey Respondents

The owners of 905 DBEs responded to the question regarding their highest level of education. Figure 22 illustrates the education background of survey respondents. Most DBE owners had either a bachelor's or master's degree. Some attended college but did not finish. Some held a doctoral with a few holding a Juris Doctor degree. A few DBE owners had an

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associate, vocational, or technical degree. Even fewer DBE owners only had a high school diploma or attended high school but did not finish. Beyond education, 157 owners had a professional engineering license, 61 owners were certified project management professionals, 35 owners were certified professional constructors, and 42 were certified erosion control technician. Other professional licenses or certifications were registered architects or landscape architects, real estate brokers or appraisers, certified construction managers, professional traffic operations engineers, certified public accountants, and Leadership in Energy and Environmental Design (LEED) accredited professionals.

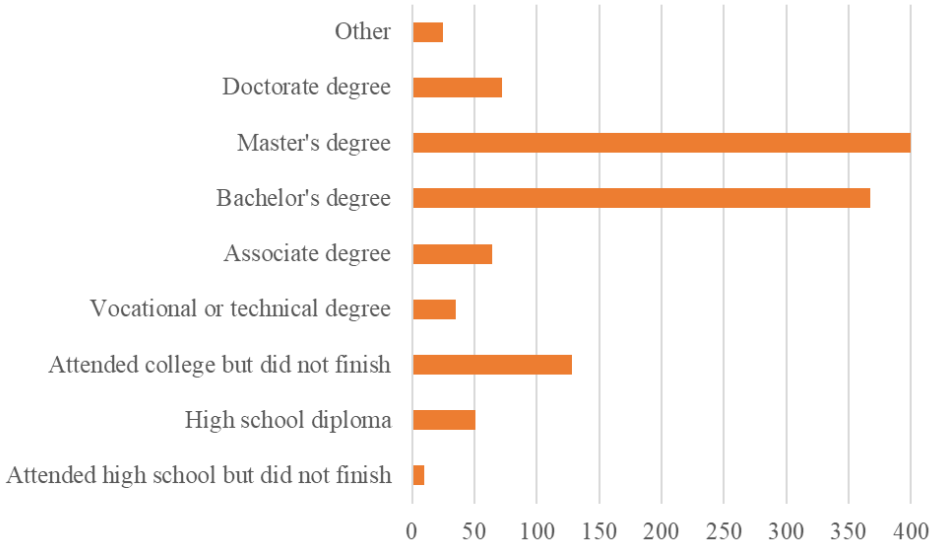

Figure 22. Education Background from Survey Respondents

The personal incomes of DBE owners tend to follow a normal distribution between $10,000 and $150,000. A relatively large number of DBE owners tend to earn either more than $150,000 or less than $10,000 annually. Figure 23 shows the personal incomes of DBE owners from survey respondents. Because business owners typically pay their employees before they pay themselves, the author assumes DBE owners earning more than $150,000 per year are relatively successful in business. However, DBE owners earning less than $10,000 may have a

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different story. Among these DBE owners, 271 responded to the question, “is your DBE a secondary (e.g., moonlighting) job/career/business?” with 198 (i.e., about 73%) selecting “no” and 73 (i.e., about 27%) selecting “yes.” Although some DBE owners earn less because of moonlighting, over 70% of DBE owners were still earning less than $10,000. Some reasons from DBEs were “Just started,” “lack of advertisement and contracts,” “lack of opportunities” because of geographic locations or business areas (e.g., IT or computer programming), and personal “illness” (i.e., bad health condition). Some DBEs explained that they had a relatively high personal income or business revenue; the income or revenue is not related to the DBE certification. A few DBEs complained that “no one value it [DBE certification],” “no job or work,” or “[the DBE program] it’s only for people who know how to game the system.”

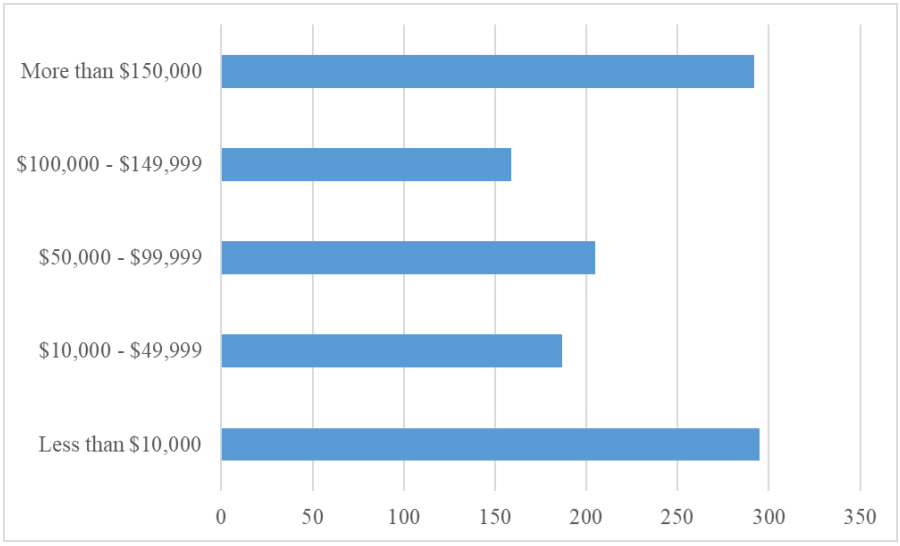

Figure 23. Personal Incomes of DBE Owners from Survey Respondents

Most DBEs have rationale years of work experience, but some have relatively less work experience. Figure 24 shows the ages of DBE owners versus years of work experience. The red line indicates that a DBE owner starts working at age 20 and has five years of work experience at age 25. The blue trend line is a cubic spline (i.e., smoother) with a default lambda of 0.05 and a

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standardized X value. Points above the red line indicate the DBE owners have work experience at an age younger than 20. Scattered points below the blue line indicate a lack of experience due to career changes or life events. The author removed unrealistic data by the rationale that the years of work experience must be less than the age. However, the author could not validate the truth of the data if the age is substantially high, and the years of work experience is relatively low. For example, one response indicates an age of 60 but only one year of work experience. Furthermore, work experience remains the same after age 75, as most people will retire and stop working.

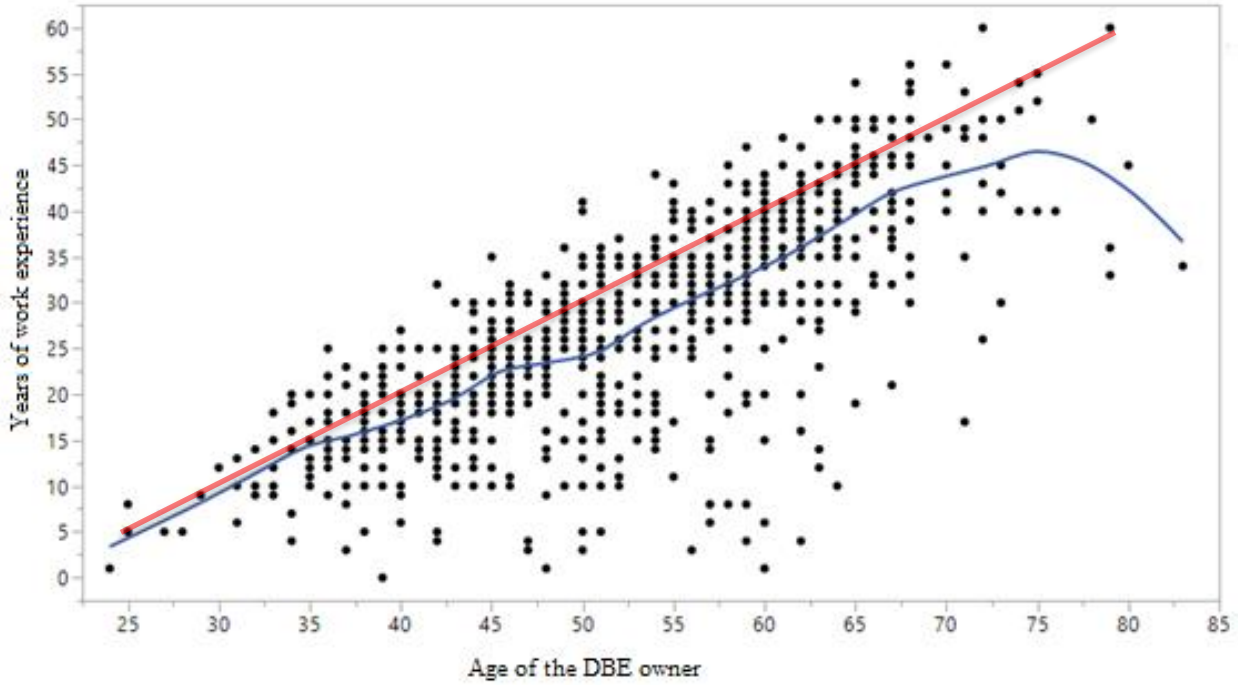

Figure 24. Age versus Years of Work Experience

Certified DBEs lose incentives and motivation to continue staying in the DBE program after 33 years of business ownership or 25 years of being a certified DBE. Figure 25 shows the years of business ownership to the years as a certified DBE. Many eligible businesses become certified DBEs after certain years of business ownership. The author cleaned the data by the

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rationale that the years as a certified DBE must be less than the years of business ownership. An eligible individual must own business before the business becomes a certified DBE. Although a DBE owner may start multiple businesses, the author is interested in the current business with a DBE certification.

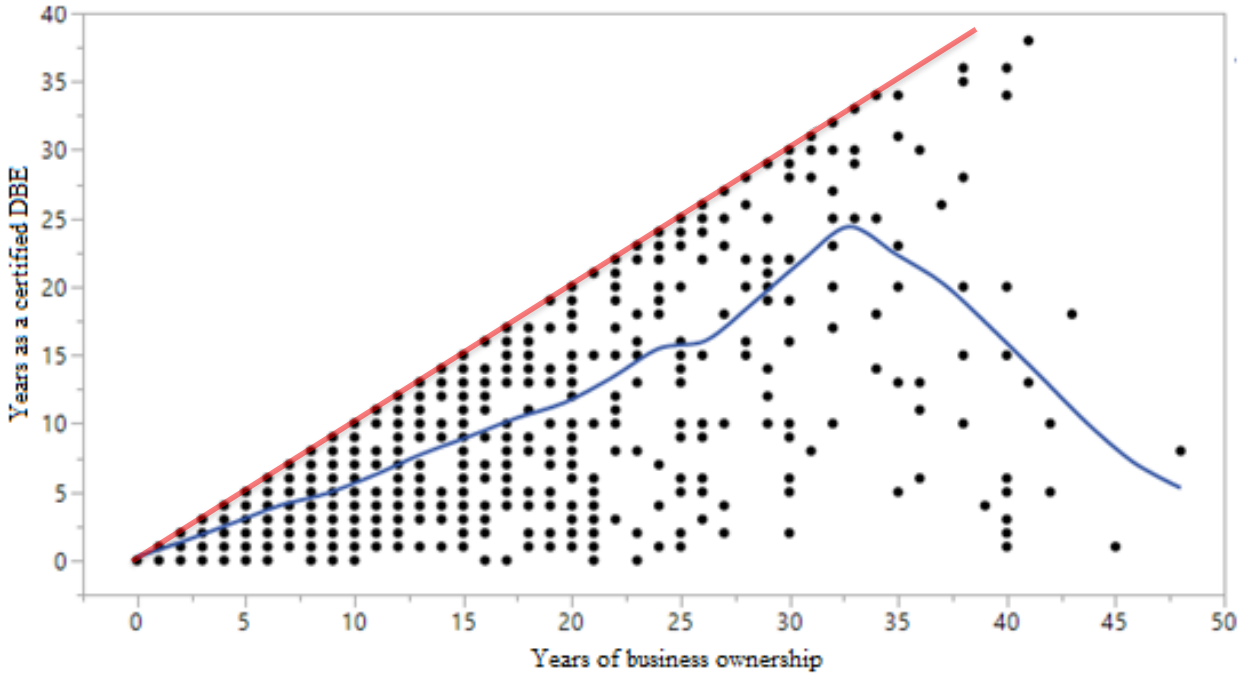

Figure 25. Years of Business Ownership versus Years as a Certified DBE

Years of being a certified DBE have a slight positive effect on the revenue of the DBE. The positive effect starts dropping after being a certified DBE for 33 years. Figure 26 shows the years as a certified DBE versus the revenue. Although relatively new DBEs have small revenue, some relatively matured DBEs still have small revenue (i.e., less than $1 million).

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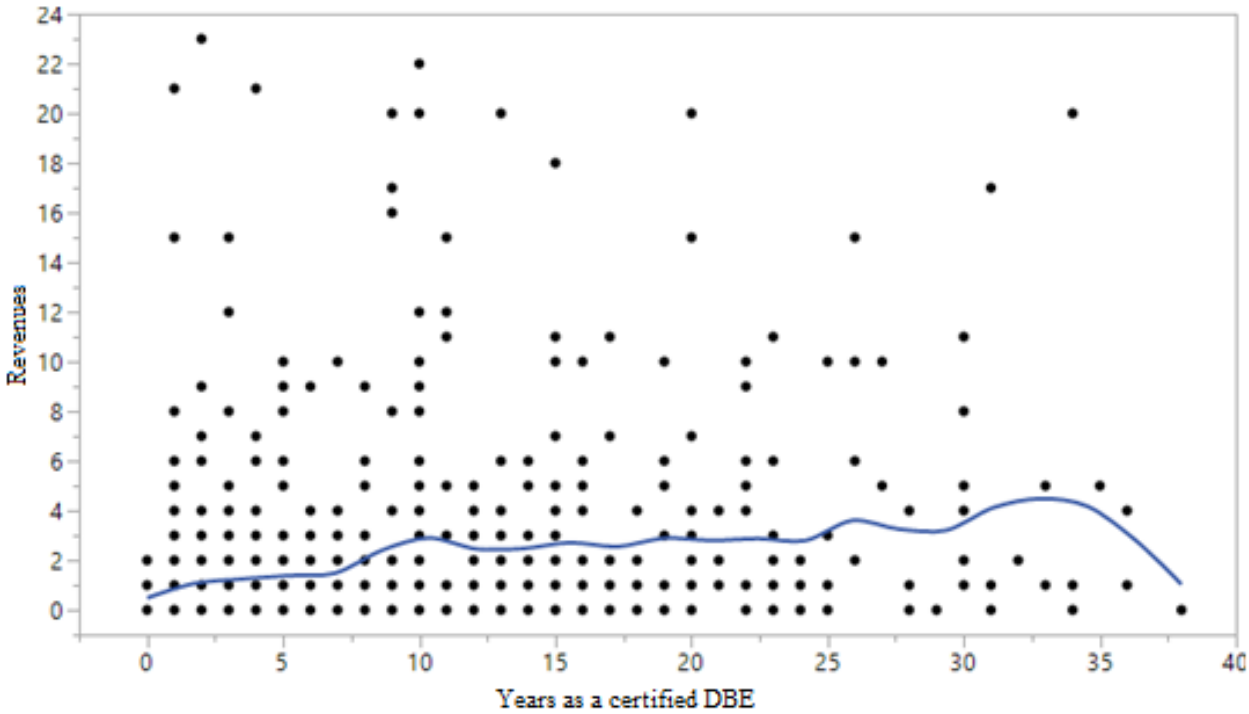

Figure 26. Years as a Certified DBE versus Revenues

The revenues of DBEs range from a few thousand to the limit of $23.98 million. The percentages of the DBE contract value in the revenue range from zero to almost 100%. Figure 27 shows revenues versus percentages of DBE work in the revenue. When the DBE percentage is high in the total revenue, the DBE program becomes more important. Consequently, it's difficult for DBEs to move out of (i.e., graduate from) the DBE program.

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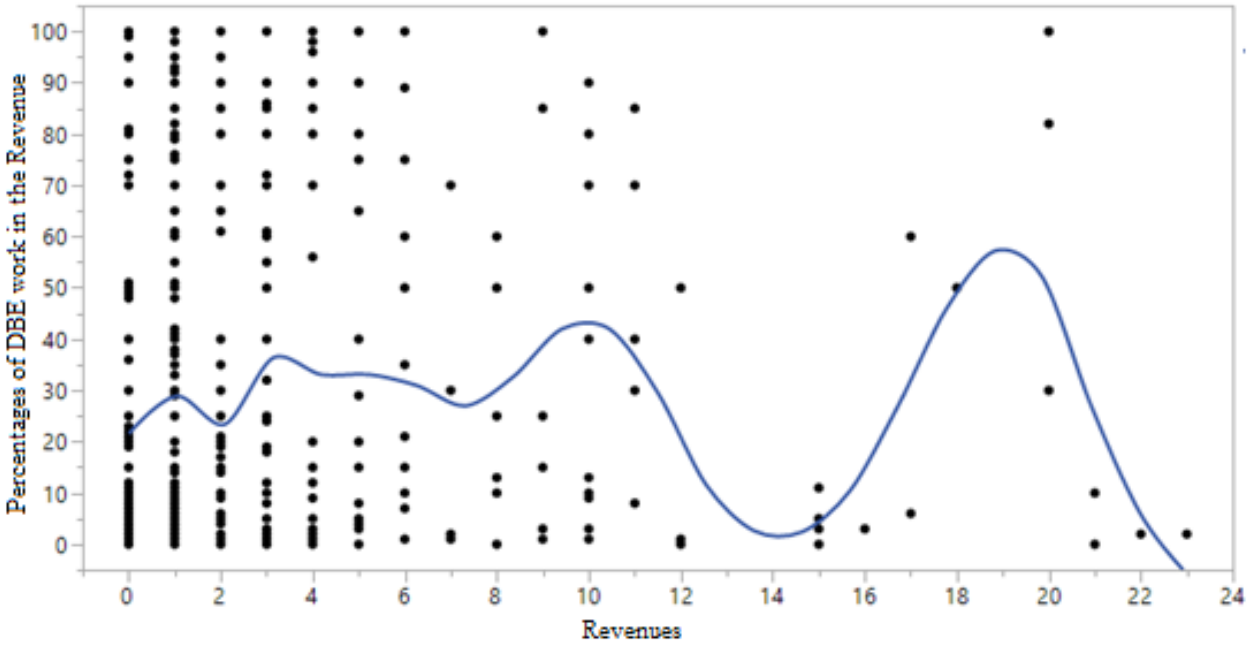

Figure 27. Revenues versus Percentages of DBE Work in the Revenue

The DBELOs expressed that many eligible businesses never heard the DBE program. Some DBEs would not get opportunities from DOTs because of the business areas were not related to DOT contracting work. Most DBEs were neither entering the Business Development Program nor using supportive services. The reasons for this are many. Some DBEs do not know about them. Others may think they are not helpful either before or after using them.

Engineering and construction

DBEs in the construction industry have a relatively higher revenue compared to DBEs in the engineering industry (also called professional services), with the attention to that most DOT-contracts are construction work, and few are engineering work. DOTs let construction contracts regularly but often contract engineering work through on-call services. The dollar value is typically high in construction contracts because of materials and equipment expenses. Furthermore, construction contractors can subcontract up to 70% or 90% of the work to subcontractors. Figure 28 illustrates the years as a certified DBE versus the revenue. A DBELO

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commented that it took a construction DBE up to seven years to build relationships and become a successful business in the DBE program. An engineering DBE may take up to three years before becoming a successful business.

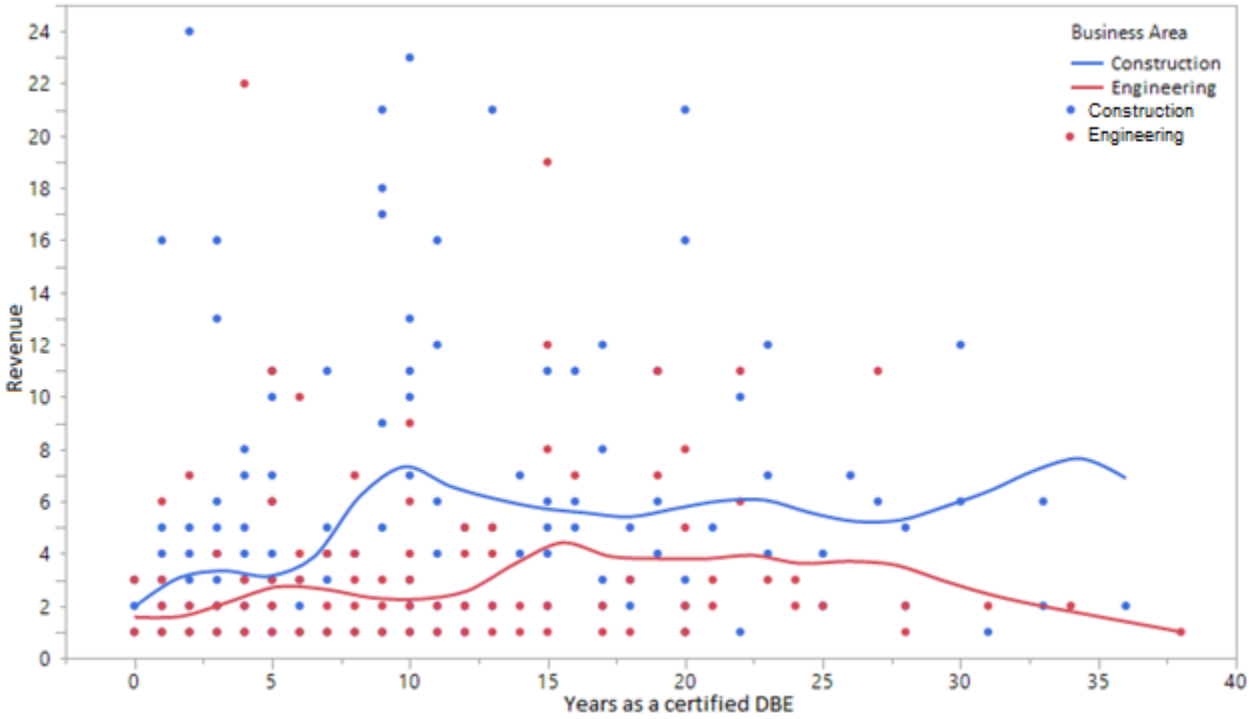

Figure 28. Years as a Certified DBE versus Revenues in Engineering or Construction

Similar to revenues, the percentages of DBE contract value depend on the business area. Figure 29 shows revenues versus percentages of DBE work in engineering and construction. Both have an average of 30% of DBE work when the revenue is less than $8 million. Engineering DBEs rely more on DBE work when the revenue is between $8 and $15 million. Then the percentage of DBE work drops significantly when the revenue exceeds $15 million. That is because the engineering DBE exceeds the revenue limit of $15 million from the SBE size standards. Then, the DBE is ineligible to be a small business and therefore is ineligible to be a certified DBE. As the DBE loses its certification, the revenue tends to drop. Some states may not decertify engineering DBEs by the $15 million size standard from Small Business

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Administration. Construction DBEs have a relatively low percentage of DBE work for revenues between $10 and $15 million. These DBEs are probably transitioning from subcontractors to prime contractors. They may lose some subcontracting DBE work and gain some DBE work as prime contractors. Engineering DBEs show a similar transition when the revenue is between $6 and $8 million.

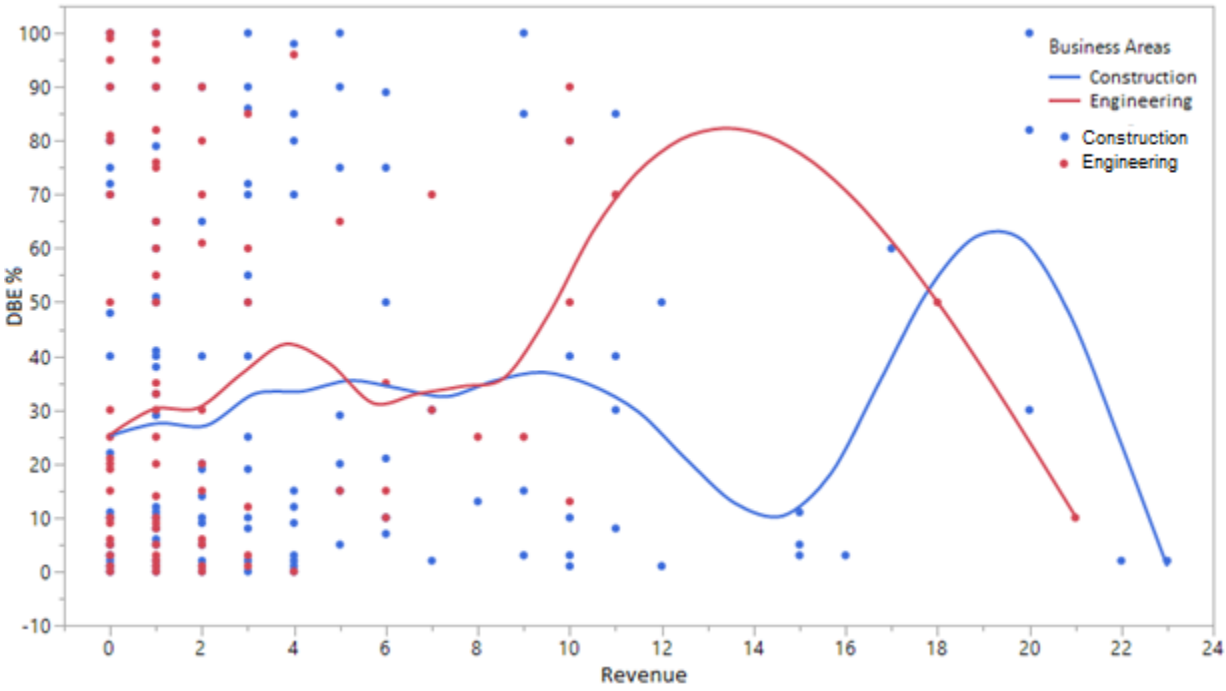

Figure 29. Revenues versus Percentages of DBE Work in Engineering or Construction

DBEs in the engineering industry have a relatively stable and reliable revenue compared to the construction industry. Construction is often influenced by weather and limited by equipment. Some Engineering DBEs are civil engineers, technology firms, planning engineers, and environmental engineers for construction.

DBEs in the construction industry tend to have a higher number of employees than DBEs in the engineering industry. A DBELO commented that DBE owners in construction often

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emerged from field labors or truck drivers. Although they were skilled workers or traders, they had inadequate office experience and struggled with business development and management.

Challenges and discussions

DBEs urge to seek social justice and a level playing field because of systemic oppression and sporadic discrimination. Thus, most DBEs are motivated or inspired to get a DBE certification in the hope of finding contract opportunities and business development assistance. However, the first controversy is whether the business fit in the program and if the DBE can find any contracting opportunity from the DOT. Most DBEs have limited knowledge and understanding of DBE programs. DBEs must know the program well so that they can use the full potential of the program and advocate equal opportunities, inclusion, and diversity in the engineering and construction industries.

Developing a relationship or breaking into the industry is very challenging for DBEs. New DBEs often struggle to find opportunities since contractors are reluctant to use new DBEs and tend to work with DBEs that they already have a relationship with in the past. Contractors frequently exchange opinions with each other. If a DBE is unprofessional or unable to perform work to meet project specifications, the DBE will be likely to lose contract opportunity from most contractors. A recommendation for newly certified DBEs is to maintain high discipline and integrity in interpersonal relations and the best quality and ethics in professional business.

DBE Program

The DBE regulations require an aspirational national goal to expend not less than 10 percent of federal funds with DBEs to fulfill the objectives of the DBE program. The regulations do not require STAs to set an overall or an individual contract goal at the 10 percent level. Some have high goals, and others have low goals, depending on the goal-setting guidance in the 49 CFR §26.45, “How do recipients set overall goals?” The regulations allow race-neutral, race-

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conscious, or a combination of both measures. Race-conscious programs set a DBE goal on a federally assisted contract based on multiple factors such as the scope of work and availability of DBEs. STAs then monitor and enforce the contract compliance to ensure the awarded contractor provides opportunities for DBEs and uses DBEs as subcontractors. Race-neutral programs aim to assist all small businesses regardless of race or gender differences and do not set a DBE goal on a federally assisted contract. Although the race-neutral program does not set DBE goals on individual contracts, DBE programs still promote the use of DBEs in federally assisted contracts. The DBELOs often target large contractors to commit DBE participation, provide bidders list to DBEs, hold pre-bid and letting meetings, and foster relationship building between primes and DBEs. Some states use a combination of race-conscious and neutral measures, which have a split DBE goal, including race-conscious and neutral goals.

Although state DOTs typically set an overall DBE goal every three years, approximately half of the states failed to meet the overall DBE goals in 2018. Table 9 shows the overall and achieved goals with the awarded dollar value in the fiscal year of 2018. The data is from the National Association of Minority Contractors (NAMC) in Washington, DC. The US DOT does not sanction or punish any state DOT for not meeting their goals. However, a state DOT failed to meet the overall DBE goal should submit an explanation or justification letter to the US DOT for review. The NCHRP synthesis 343 also found approximately half of 36 states not meeting their goals in 2002. Despite the goal-setting methodology, the DBE program relied on the goal to measure the achievement of the significant objectives. The regulations should enforce the achievement of the DBE goal, especially when the achieved goal is 10% or more below the aspirational goal. A DBE interview participant commented that inconsistent goals negatively

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affected DBEs. A state DOT dropped the overall DBE goal by half, resulted in DBEs losing contracting opportunities during an economic boom.

Table 9. Overall and Achieved Goals in the Fiscal Year of 2018 (NAMC, 2018)

State	Awards	Overall	Achieved	State	Awards	Overall	Achieved
AL	$739,204,900	12.72%	11.09%	**MT**	$340,214,742	6.14%	5.10%
AK	$247,560,586	8.83%	8.06%	**NE**	$295,306,456	6.21%	6.85%
AZ	$384,383,143	9.55%	12.76%	**NV**	$317,537,991	3.58%	5.87%
AR	$509,863,792	8.58%	11.15%	**NH**	$111,990,599	5.70%	7.25%
CA	$2,437,956,903	12.50%	14.03%	**NJ**	$466,722,497	12.44%	15.81%
CO	$366,647,893	12.15%	13.01%	**NM**	$249,177,787	15.51%	30.76%
CT	$489,031,526	13.00%	13.50%	**NY**	$1,747,923,813	12.23%	15.09%
DE	$153,004,533	13.80%	10.58%	**NC**	$1,594,916,277	13.70%	14.87%
FL	$2,577,334,387	10.65%	13.00%	**ND**	$300,601,258	4.91%	5.02%
GA	$581,063,280	16.00%	18.20%	**OH**	$1,276,646,042	15.60%	11.77%
HI	$156,371,106	29.05%	7.43%	**OK**	$668,446,490	9.20%	11.29%
ID	$538,304,807	8.30%	3.29%	**OR**	$374,557,587	11.60%	8.94%
IL	$810,331,784	18.70%	11.69%	**PA**	$1,736,114,330	9.38%	7.98%
IN	$1,250,784,152	10.90%	12.35%	**RI**	$160,296,931	11.89%	15.42%
IA	$564,786,769	5.94%	5.58%	**SC**	$256,369,405	13.20%	9.06%
KS	$322,377,640	8.01%	8.75%	**SD**	$276,756,939	6.47%	12.11%
KY	$461,032,327	11.95%	10.44%	**TN**	$787,187,090	7.69%	8.30%
LA	$451,139,965	13.09%	12.99%	**TX**	$3,795,287,395	12.60%	12.71%
ME	$267,309,372	2.00%	3.98%	**UT**	$275,826,063	5.33%	7.38%
MD	$659,158,378	27.16%	18.20%	**VT**	$261,812,926	6.46%	8.70%
MA	$496,886,355	14.80%	14.08%	**VA**	$1,325,582,022	10.80%	11.49%
MI	$1,299,293,548	9.34%	6.91%	**WA**	$275,891,588	19.00%	9.28%
MN	$582,865,670	11.70%	9.43%	**WV**	$126,055,813	8.77%	9.02%
MS	$395,431,733	11.80%	8.82%	**WI**	$1,010,715,966	12.33%	13.09%
MO	$883,833,849	15.38%	13.79%	**WY**	$226,442,877	4.55%	4.86%
DC	$90,909,929	27.67%	13.64%				

Core functionalities

The core functionalities of the DBE program are certification, administration, compliance, analytics, and outreach (CACAO), as shown in Figure 30. These core functionalities, emerged from qualitative analysis of interview data, correlate with each other and

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serve the purposes and objectives of the DBE program. A previous understanding is that the DBE program has only two functions: certification and administration. Compliance is the responsibility of the contracting office. Outreach is a part of supportive services. There is no or minimum analytics on the data collected and retained. The emerged CACAO functionalities are the core of the DBE program. Missing one or more of these essential functionalities will sabotage the quality of the program significantly.

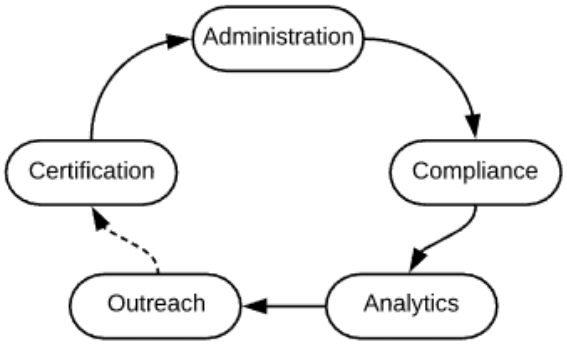

Figure 30. Core Functionalities of DBE Programs

Certification allows DBE to participate in the DBE program and compete on federally assisted contracts. Understanding the definition and requirement of the latest DBE final rule is critical to ensure only eligible and legitimate DBEs to participate in the program on federally assisted contracts. The latest DBE final rule describes eligibility criteria are (1) the certified DBE must be at least 51% owned and controlled by both socially and economically disadvantaged individual(s), (2) the personal net worth must not exceed $1.32 million, (3) the three-year average revenue must not exceed $23.98 million, and (4) the DBE must perform commercially useful function. The DBE regulations refer to the SBA for a small business. The SBA defines a small business by size standards, such as the number of employees, the average annual revenue, and affiliates. Some DBEs may exceed the size standards by the SBA before exceeding the specific revenue limit of $23.98 million by the DBE program. A directory of certified DBEs is

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publicly available for contractors to contact for their services. In addition to the application, the DBELO conducts an onsite interview or field visit to validate the application. Then, DBELO typically requires an annual update of an affidavit no change to maintain the DBE certification. DBEs can attain certification from other states through the unified certification program (UCP). UCP is an interstate certification platform that minimizes the paperwork and onsite visits. However, UCP has some inconsistent requirements from different states. The business must be a certified DBE in the home state before applying for DBE certification from other states. A state DOT DBE program may need additional documents to certify a DBE.

Administration involves a series of effective practices: setting a triannual DBE goal and individual DBE goals on contracts; preparing plans, procedures, and reports; tracking DBE commitment and attainment; conducting disparity and availability studies, and sanctioning violations or fraud. Some state DOT DBE programs provide administrative support to remove barriers for DBE to participate in federally assisted contracts. Some administrative practices are unbundling large contracts, providing financial assistance through loan mobilization program, and arranging solicitations or providing contracts (i.e., small and suitable contracts but not a set-aside) to DBEs. Although administrative practices of the race-neutral program are very similar to, sometimes are a part of supportive services provided to DBEs, the author distinguishes administrative practices from supportive services. Administrative practices are means and methods from DBE administrators to remove barriers of DBE participation. Supportive services mainly provide training and assistance from a specialized team to support DBE development.

Compliance (i.e., contract compliance) enforces commercially useful function, good-faith effort, prompt pay provision, Davis-Bacon prevailing wages, and DBE fraud detection and prevention. Complaint and investigation are integral parts of the compliance effort. Field officers

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are performing commercially useful function (CUF) reviews as well as on-site interviews. When a prime contractor cannot meet the DBE contract goal, the DBELO needs to assess the good-faith effort of the contractor. The DBELO will sanction repeated offenders of the DBE contract goals without good faith effort. DBELOs also review and approve the termination and replacement of non-performing DBEs.

Analytics primarily serves for the administration and provide firm ground for DBE goal-setting. Data in both qualitative and quantitative formats need substantial analytic efforts. Some states identify RWA DBEs in different contracting areas and use the data to set both the overall DBE goal and the DBE contract goal. Other use analytics in disparity and availability studies, DBE goal commitment and attainment, and tracking of race-conscious and neutral goals.

Outreach is about networking and advocating for the DBE program. It supports both certification and compliance. Previous outreach focused on marketing the DBE program and getting eligible businesses certified as DBEs. Therefore, the number of certified DBEs increased significantly in the DBE program. Many DBELOs commented that outreach should focus on advocating the objectives of the DBE program and educating eligible businesses to find the fit between the business and the program. Another effort of outreach is to periodically send DBE newsletters and email blasts, containing lists of general contractors for ongoing projects, lists of bidders for current lettings, and contracting opportunities for upcoming projects.

Unique practices

Many unique practices existed in DBE programs operated by different DBELOs. A few examples were 1) maintaining a non-DBE list so that DBE could contact them for work and 2) providing comprehensive training of the DBE program to all entities at all project levels. Some states used a DBE specialist to do everything in a small region. Other states had a team managing a large region or the entire state by assigning different officers with different roles.

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Challenges and discussions

The DBE program is a powerful tool to ensure nondiscrimination and create a level playing field for all enterprises, especially small and disadvantaged business enterprises. DBE goals are the core metrics for measuring the achievement of the program objectives but do not tell a full story.

Diverse businesses are certified DBEs, but the DOT only has engineering and construction contracting opportunities. Although local municipals or private organizations recognize DBE certification from the DOT and some DBEs are getting contracting opportunities from them, this creates a level of complexity in the DBE program. The author recommends that the DBE program identify RWA DBEs by their business areas.

DBEs are unwilling to move out of (i.e., graduate from) the DBE program because of losing contracting opportunities, particularly contracts that have a DBE goal. Additionally, there is no successful pathway for DBEs to compete successfully outside of the DBE program. DBEs often lose contracting opportunities after graduating from the program because of exceeding the annual revenue limit. Then, the annual revenue of the DBE drops below the revenue limit of the program. The DBE re-enters the DBE program and becomes a certified DBE again.

Supportive Service Program

DBE supportive services include a wide variety of topics. Common Supportive services are on-the-job training (OJT), mentor-protégé program (MPP), and business development program (BDP). Often, the MMP and BDP are independent but sometimes are a part of the supportive services program.

Some define administrative practices of removing barriers to the participation of DBEs as a part of supportive services. These practices include, but are not limited to, unbundling large contracts and waiving bonding requirements. The author focus on supportive services assist the

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development of the DBEs by creating contracting opportunity, providing informative workshops and technical training, and facilitating programs that focus on building capabilities and capacity.

Common supportive services

Common supportive services offer workshops or training on a variety of topics such as new DBE orientation, networking events, annual conferences, and specific courses or training on quantity and cost estimating, bid and proposal preparation, marketing, financial assistance, access to bonding or capital. The DBE orientation is for newly certified DBEs and provides various introductory topics about the DBE program. These topics include, but are not limited to, program overviews, certification procedures, compliance requirements, potential opportunities, supportive services, upcoming events, and doing work with DOT.

Many state DOT DBE supportive service programs offer networking events with prime contractors. Some of these events are called “meet the prime,” “meet and greet,” “speed networking,” or “roundtable discussions.” Networking events are often integrated into annual conferences. Sometimes, DBEs also network in project meetings or business engagement events. For example, Arizona DOT organized an Expo for project opportunities that allow DBEs to meet and network with other contractors.

Some supportive services have no specific topics and allow individualized assistance. These are one-on-one consultations and reimbursement programs for DBEs. The one-on-one consultation is typically for business development or program assistance. Reimbursement program allows DBEs to access to education, conferences, or software. DBEs will get partial or full reimbursement for courses at their interests.

Furthermore, OJT provides training to individual employees or new workers as an effort of workforce development. Some OJTs are specifically for DBEs and benefit DBE employees. Some STAs create DBE University (e.g., Pennsylvania) or academy (e.g., Minnesota) in the

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hope of developing a comprehensive supportive service program for DBEs in collaboration with locally available resources, programs, and centers.

Mentor-protégé program

Some state DOTs operate a mentor-protégé program to support and assist the development of DBEs. Often, the program uses a non-DBE prime contractor as a mentor and a DBE as a protégé. For example, Washington State DOT has a mentor-protégé program that uses a non-DBE prime contractor as a mentor for a DBE as a protégé to assist with the development of the DBE. One DBELO indicated a different approach where the supportive service provider acted as the business advisor and mentor and the DBE as a protégé.

The US Small Business Administration also promotes mentor-protégé programs, especially in the 8(a) program. The purpose of the mentor-protégé relationship is to enhance the capability of the protégé, help the protégé meet the goals established in the business plan, and improve the protégé's ability to compete for contracts. The program assists with technical or management training, financial assistance, trade education, and government contracting.

Business development program

A business development program from Tennessee or Arizona states provides a series of classes for DBEs to grow and meet their goals outlined in a business plan. The BDP usually separates DBEs into various groups based on their business areas and revenues. Because DBEs are neither willing to graduate nor sustainable after graduation, the BDP is often about development in the DBE program, not transition out of the DBE program.

Challenges and discussions

Limited funding and inadequate staff are two significant challenges of the supportive service program. Additionally, it is essentially challenging for providing supportive services to diverse DBEs in various business areas and stages of development. The most significant

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challenge for common supportive services is the lack of a framework for a variety of topics. DBELOs and supportive service providers often do not know the needs of DBEs or the best way to support them. Often, supportive services are introductory or inefficient to DBEs. Sometimes, low attendance in supportive services is a major challenge, especially when DBEs are busy in a booming economy.

Challenges for the mentor-protégé program are finding and matching both mentors and protégés. Although some states successfully use non-DBEs to mentor DBEs, DBEs express that they need to learn from other DBEs. Because the best knowledge is often from peers, the mentor-protégé program should try to use successful DBEs to mentor newly emerged DBEs. Also, federal agencies should support DBELO to learn best practices from each other.

The BDP has no clear framework or pathway with limited practices from a few states. Although a BDP has both developmental and transitional stages, most BDPs focus on the development of DBEs, resulting in few or no DBEs move out of (i.e., graduate from) the DBE program. Some state DBELOs commented that their BDP focus on the development of DBEs because DBEs are unwilling and unable to graduate from the program or compete successfully outside of the DBE program.

Conclusions and Recommendations

This study is the first step towards enhancing our understanding of DBEs and DBE programs through holistic perspectives, including both DBEs and DBELOs. The synthesized characteristics of DBEs and practices of DBE programs was achieved through a literature review, survey responses from DBEs nationwide, and interviews with DBELOs from ten states. The author found the following characteristics of DBEs: 1) a large number of DBEs certified in a state yet only a small number of DBEs participated in federally assisted contracts; 2) about 90 % of sampled DBEs have a revenue less than $5 million; 3) about a quarter of sampled DBEs are in

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construction contracting and another quarter of sampled DBEs are in engineering consulting; 4) most DBE owners have a bachelor's degree or higher, and some emerge from trades without a college degree while a few others have doctoral degrees; 5) DBEs can stay in the program for a long time but generally tend to lose the DBE status and revenue around 33 years in business or 25 years as a certified DBE; and 6) DBEs in engineering perform slight more percentage of DBE work in the revenue with less overall revenue than DBEs in construction.

Each state DOT operates and manages its DBE program under the oversight of federal agencies and in compliance with federal regulations. However, state practices are different depending on the interpretation of regulations and laws, DBE characteristics and needs, leadership and initiatives from government agencies, and available support and local resources. About half of the states failed to meet the overall DBE goals in 2018. First, the goal-setting must be consistent with gradual changes, if any. Second, the DBE goal must be enforced even there is no penalty for not meeting the goal. Third, supportive services should follow a framework to assist business development at all levels. Current supportive services have no system or framework to assess the needs or measure the outcomes. Most supportive services provide basic information and speed networking for new and emerging DBEs. Certified DBEs have limited assistance and no growth or development pathways in the DBE program.

Although the DBE program encourages or mandates general contractors use DBEs on federally assisted contracts, problems still exist because general contractors are reluctant to work with new DBEs due to high risk (e.g., uncertainty and lack of relationship and trust). A few recommendations for the DBE programs are to 1) promote recognition in new, emerging, and successful DBEs, 2) foster sustainable and contractual relationships for DBEs, 3) encourage partnership and joint ventures, and 4) increase critical data collection. Furthermore, the author

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recommends the DBE program allow DBEs to participate in the race-neutral goals as MBEs and WBEs after they graduate from the DBE program and promote diversity and inclusion initiatives in corporate social responsibilities.

Limitations and Future Research

Although the research data was representative, two major limitations were voluntary participation from DBE and DBELOs. Most DBE owners declined to participate in the research because of previous experience in DBE scams. Some DBE owners emailed or called to verify the identity of the author and the legitimacy of the research. The author promptly responded to both emails and phone calls. Some DBE owners opted out of the survey invitation or replied to ask to be removed. The author immediately removed these DBE owners from the survey invitation and any future reminders. Also, survey results were highly dependent on the honest feedback from DBEs. The author identified some unrealistic survey responses and removed them from data analyses. For instance, a response indicated years of work experience was more than the age of the respondent. Another limitation of the research design was the length of the survey (i.e., the number of questions). The author carefully considered the options of one comprehensive survey versus multiple individual surveys. Because each survey needed a minimum of two reminders, the author decided to send one comprehensive survey invitation with two email reminders to each DBE. Consequently, the author received feedback that the survey was too long to complete under a busy schedule between June and July of 2019.

Although the author conducted interviews with DBELOs from ten states, more interviews could have been collected. Typical limitations were inaccurate DBELO contact information on federal or state websites. After a minimum of two emails and one phone call with 50 states, the author received 16 responses. Of which, ten participated in interviews; four refused to participate; One offered the opportunity to relevant staff, but no further responses; and one

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wished to only participate in a survey due to short staffing. The rest either had no responses or referred to another contact that did not respond. As a result, the author only collected interviews from ten states.

Additionally, the author designed and sent a survey to all states to collect quantitative data. Only four states responded to the survey. The author used survey responses as supplementary data but could not conduct any statistical analysis. The low response rate from DBELOs was essentially due to a lack of consistent and systematic information about DBEs and DBE programs. Many might not know the answer to the questions because the data was not collected. Additionally, previous dispute resolutions, administrative sanctions, and legal challenges made the DBE the least popular topic to discuss with others.

Future research should focus on the success of DBE by establishing a consistent and systematic data collection system, developing business growth models, providing effective supportive services, identifying their leadership, and promoting diversity and inclusion in federally assisted contracts.

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Disclaimers

The author remains exclusively responsible for the data presented in this paper. The author claims all original work in this study, such as the creation of the survey and analyses of qualitative and quantitative data. The views and opinions expressed in this article are those of the author and do not necessarily reflect the official policy or position of any business entity or

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agency of the US government. The paper is not a compliance review of the DBE program; therefore, it does not address whether state DOTs are following or enforcing the regulations. The paper does not constitute a standard, specification, or regulation.

Data Availability Statement

Some or all data, models, or code generated or used during the study are proprietary or confidential in nature and may only be provided with restrictions (e.g., anonymized data). Data will be permanently deleted upon completion of the research study.

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CHAPTER 5. VARIABLE CLUSTERING AND PRINCIPAL COMPONENT ANALYSIS OF CHALLENGES FROM DISADVANTAGED BUSINESS ENTERPRISES

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Abstract

Disadvantaged Business Enterprises (DBEs) have many challenges due to compounded factors of being small, disadvantaged, local, minority-, and women-owned. Disadvantaged individuals (e.g., women or minorities) experience systemic oppression and sporadic discrimination, which leads to diminished contracting opportunities, limited access to capital, and unprecedented challenges in business. The author developed 16 factors in business challenges and 15 overall statements about DBEs based on previous literature. Both are constructed in a survey using a five-point Likert scale. The author collected 460 responses for these 31 factors (i.e., 16 business challenges and 15 overall statements). To explore and explain DBE challenges, the author reduced data dimensions using variable clustering technique and principal component analysis. The author identified seven variable clusters and five principal components representing more than 50% of the observed data from all factors and observations. These clusters and components help researchers, policymakers, DBEs, government agencies, and professional organizations understand the critical challenges of DBEs and their importance in principle components.

Introduction

A Disadvantaged Business Enterprise (DBE) is a small, for-profit business owned and controlled by both socially and economically disadvantaged individuals such as women or minorities. The United States (US) Department of Transportation (DOT) has a DBE program defining seven presumably disadvantaged groups. These groups are Black, Hispanic, Native,

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Asian-Pacific, Subcontinent Asian Americans, and white women (i.e., Caucasian) as well as any other groups designated by the Small Business Administration (SBA). The DBE program ensures nondiscrimination in the award and administration of DOT-assisted contracts, helps remove barriers to the participation of DBEs in DOT-assisted contracts, and assists the development of firms that can compete successfully in the marketplace outside of the DBE program (US DOT 2016a). The DBE regulations require state transportation agencies (STAs) to establish annual DBE goals for DOT-assisted contracts so that, at a minimum, a certain percentage (i.e., overall 10%) of federal funds expends on DBE work. STAs use both race-conscious (i.e., including both race and gender) and race-neutral approaches. The race-conscious approach sets a DBE goal on an individual contract and requires the awarded contractor to use DBEs and comply with the contract requirements. The race-neutral approach promotes the use of DBEs without a DBE goal on any specific contract. However, the use of DBEs is strongly encouraged and is counted toward the race-neutral goal, which is a part of the overall DBE goal for an STA.

Although the DBE program has increased DBE participation in federally assisted contracts, most DBEs still face many business, program, and societal challenges. These challenges are complex with qualitatively unstructured and amorphous descriptions. The objective of this research is to evaluate challenges quantitatively and help researchers, policymakers, DBEs, government agencies, and professional organizations understand the challenges of DBEs.

Literature Review

Both the US GAO and DOT OIG released reports critiquing various weaknesses of the DBE program and critical information needed to achieve its significant objectives. The US GAO (1985) identified some common difficulties for DBEs, such as obtaining bonds, slow payment,

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retainages, or access to capital, loans, or credits. Although DBEs were capable of performing 10% of the highway work and had no problems with licensing or prequalification, insufficient data were available to determine and validate the necessary level of competency and expertise of DBEs. The US GAO (1994) commented on many refinements on the DBE program, such as ineffective supportive services and limited effort in developing successful and self-sustaining DBEs.

Additionally, the US GAO (2001) found that most STAs could not provide critical information about DBEs, such as annual gross receipts. Limited information was available on characteristics of DBEs, electronic databases, and the impact of the DBE program. The US DOT OIG released an audit report named "Weaknesses in the Department's Disadvantaged Business Enterprise Program Limit Achievement of Its Objectives" on April 23, 2013. The report indicated an increasing effort in DBE fraud investigations due to several weaknesses of the DBE program, such as lack of a single line of accountability, limited communication or available data, insufficient oversight, and inadequate effort in assisting DBE development.

Previous research in the literature identified many challenges of DBEs. A summative statement is that DBEs struggle with issues of being small compounded with the disadvantaged status (Glover 1975). One of the most significant barriers to DBE utilization was reported to be the lack of resources (e.g., financial, bonding, and insurance) available to DBE contractors (NCHRP 2005). These challenges and barriers are from anecdotal evidence and lack of quantitative measurement.

Research Methodology

The author uses a quantitative method in this research. First, the author obtained contact information from state DOT DBE programs. Then, removed all duplicates and identified unique DBEs by the owner's name and email address. The author sent a survey to 35,178 DBEs with

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two reminders between June and July 2019. A total of 1,384 DBEs responded to the survey. Although the response rate is low (i.e., approximately 3.4%), the number of responses is geographically representative and statistically significant. After removing incomplete surveys, the author identified 447 to 465 complete responses on various factors of interest for this paper. After removing missing data, the author used approximately 370 observations in variable clustering and principal component analyses. Variables are measured on a five-point Likert-scale. Survey participants can select one of the given options for each challenge or statement. Below are business challenges and overall statements in the survey.

Business Challenge (BC): Please rate the degree you are experiencing the following business challenges with choices of not applicable, no challenge, minor challenge, somewhat challenge, and major challenge.

BC_1 Finding contracting opportunities in general.

BC_2 Diminished opportunities because of my race or gender.

BC_3 Marketing my business and networking with others.

BC_4 Finding capital such as loans.

BC_5 Getting surety bonds or increasing bonding capacity.

BC_6 Managing cash flows and preparing financial statements.

BC_7 Using electronic bidding systems or technology.

BC_8 Navigating project letting and bidding process.

BC_9 Finding new and retaining existing skilled workers.

BC_10 Having or working with someone who has language barriers.

BC_11 Bias and/or discrimination from prime contractors.

BC_12 Bias and/or discrimination from DOT staff.

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BC_13 Strong competition because of DBE overconcentration.

BC_14 Delayed payments or withheld retainages.

BC_15 Bid shopping by primes after contract award.

BC_16 Managing and maintaining the relationship with contractors, consultants, clients, subcontractors, or sub-consultants.

BC_17 Other, please explain _____.

Overall Statement (OS): How strongly do you agree or disagree with the following statement? The choices include strongly disagree, disagree, neutral, agree, and strongly agree.

OS_1 DBEs struggle with issues of being small compounded with the disadvantaged status.

OS_2 Being a certified DBE increases contracting opportunities.

OS_3 DBEs deliver competitive and quality products or services.

OS_4 DBEs are sometimes unable to complete work on time or schedule.

OS_5 DBEs are sometimes unable to perform work that meets project specifications.

OS_6 There is no incentive for primes to use me unless the DBE program requires them.

OS_7 Primes are not eager to work with DBEs and reluctant to use new DBEs.

OS_8 Being a certified DBE, I will lose the protection from discrimination if I move out of (graduate from) the DBE program.

OS_9 The old boy network still exists and prevents DBEs from networking.

OS_10 Large DBEs overshadow small DBEs making it difficult for small or new DBEs to grow.

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OS_11 DBE programs ensure nondiscrimination in the award and administration of federal-assisted contracts.

OS_12 DBE programs level the playing field for all enterprises.

OS_13 Supportive services remove barriers for DBEs.

OS_14 Supportive services help DBEs develop their business.

OS_15 Joining associations (e.g., AGC, ASCE) has substantial benefits.

The author used both variable clustering and principal component analysis (PCA) to analyze the observed variables. Each cluster has multiple variables with corresponding scores; the variable with the highest score is the most representative variable in a cluster. Variable clustering assesses collinearity and redundancy by separating variables into clusters. Variable clustering constructs components that are linear combinations of variables in a cluster of similar variables. Cluster components are not orthogonal because they are constructed from distinct sets of variables. Similarly, PCA analyzes the data table and extracts the most crucial information as a set of principal components. Each component is a smaller number of independent linear combinations (i.e., principal components) of a set of variables in terms of variation. Principal components constructed from a set of variables are orthogonal.

Variable clustering

Variable clustering arranges similar variables into representative groups (i.e., clusters) using an algorithm based on the singular value decomposition. The proportion of variance explained by the first principal component among the variables in the cluster. If there is only one variable in the cluster, then this is one. The statistic is based only on variables within the cluster rather than on all variables. The Standardized Components report gives the coefficients that define the cluster components. These coefficients are the eigenvectors of the first principal component within each cluster. A cluster is constructed using the first principal component of the

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variables in the cluster and is a linear combination of all variables in the cluster that explains as much of the variation as possible. The most representative variable is the cluster variable that has the largest squared correlation within its cluster. The most representative variable in the cluster represents the cluster in a large set of variables and observations. Instead of using a large set of variables in modeling, either the cluster components or the most representative variable in the cluster can be used to explain most of the variation in the data. Also, dimension reduction using cluster variables is often more interpretable than dimension reduction using principal components.

Principal component analysis

The purpose of the principal component analysis (PCA) is to derive a small number of independent linear combinations (i.e., principal components) of measured variables that capture as much of the variability in the original variables as possible. PCA is a technique for dimension reduction in exploratory data analyses. It shows the most prominent directions of the high-dimensional data. PCA reduces the data dimensionality and is a way to picture the structure of the data as completely as possible by using as few components as possible. Each principal component is calculated by taking a linear combination of an eigenvector of the correlation matrix (i.e., covariance matrix or sum of squares and cross products matrix) with the variables. The eigenvalues represent the variance of each component in the total sample accounted for each factor from all observations. Typically, an eigenvalue greater than 1.0 is significant in representing the overall data.

Descriptive Survey Results

The survey participation is voluntary to DBEs. Participants have the right to terminate the survey at any time or skip any question in the survey. Therefore, some recorded surveys are

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incomplete, and some have missing data for one or more questions. The author uses all available data in descriptive statistics.

Business challenges

Of the 1,384 survey responses, data observations range between 458 and 465 for the 16 factors in business challenges as well as one another factor for other factors explained by survey respondents. Table 10 shows the rating of business challenges from survey respondents.

Table 10. Rating of Business Challenges from Survey Respondents

Description	ID#	Not Applicable	No challenge	Minor challenge	Somewhat challenge	Major challenge
Finding contracting opportunities in general	BC_1	16	160	210	51	28
Diminished opportunities because of my race or gender	BC_2	51	192	170	31	15
Marketing my business and networking with others	BC_3	16	194	206	37	10
Finding capital such as loans and credits	BC_4	92	128	175	32	37
Getting surety bonds or increasing bonding capacity	BC_5	252	87	86	15	22
Managing cash flows and preparing financial statements	BC_6	21	188	196	33	26
Using electronic bidding systems or technology	BC_7	89	232	118	21	5
Navigating project letting and bidding processes	BC_8	71	215	140	30	8
Finding new or retaining existing skilled workers	BC_9	66	75	240	42	40
Having or working with someone who has language barriers	BC_10	144	217	84	11	6
Bias and/or discrimination from prime contractors	BC_11	50	162	194	34	21
Bias and/or discrimination from DOT staff	BC_12	71	240	117	22	13
Strong competition as a result of DBE overconcentration	BC_13	47	213	156	34	12
Delayed payments or withheld retainages	BC_14	39	120	209	45	50
Bid shopping by primes after contract award	BC_15	110	114	178	27	29
Managing and maintaining relationship with others	BC_16	18	233	165	35	7
Other, please explain	BC_17	64	18	35	3	16

Most DBEs experience no or minor challenges, with some experience somewhat or major challenges in businesses. The author describes the five options into three groups based on similarities in the numbers of responses. Group A is the “not applicable” column. Group B is the columns of no and minor challenges. Group C is the columns of somewhat and major challenges. When ranking business challenges that are not applicable, the top five are getting surety bonds or increasing bonding capacity (i.e., BC_5), having or working with someone who has language barriers (i.e., BC_10), bid shopping by primes after contract award (i.e., BC_15), finding capital

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such as loans and credits (i.e., BC_4), and using electronic bidding systems or technology (i.e., BC_7). A large number of DBEs indicate that getting surety bonds or increasing bonding capacity (i.e., BC_5) is not applicable. Some DBEs may be small and do not need bonding. Other DBEs may not be in a sector that requires bonding.

When ranking business challenges that are major challenges, the top five are delayed payments or withheld retainages (i.e., BC_14), finding new or retaining existing skilled workers (i.e., BC_9), finding capital such as loans and credits (i.e., BC_4), bid shopping by primes after contract award (i.e., BC_15), and finding contracting opportunities in general (i.e., BC_1). The author noticed that twice as many of DBEs in other fields have rated finding contracting opportunities (i.e., BC_1) as minor, somewhat, or major challenges compared to DBE in either engineering or construction. One rational reason is that state DOTs have more contracting opportunities in either engineering or construction than any other business area. When ranking somewhat challenges, the top five are finding contracting opportunities in general (i.e., BC_1), delayed payments or withheld retainages (i.e., BC_14), finding new or retaining existing skilled workers (i.e., BC_9), marketing my business and networking with others (i.e., BC_3), and managing and maintaining relationships with other contractors and consultants (i.e., BC_16).

When ranking minor challenges, the top five are finding new or retaining existing skilled workers (i.e., BC_9), finding contracting opportunities in general (i.e., BC_1), delayed payments or withheld retainages (i.e., BC_14), marketing my business and networking with others (i.e., BC_3), and managing cash flows and preparing financial statements (i.e., BC_6). When ranking no challenge, the top five are bias and discrimination from DOT staff (i.e., BC_12), managing and maintaining relationship with other contractors and consultants (i.e., BC_16), using

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electronic bidding systems or technology (i.e., BC_7), having or working with someone who has language barriers (i.e., BC_10), and navigating project letting and bidding processes (i.e., BC_8).

Overall statements

Of the 1,384 survey responses, data observations range between 447 and 452 for the 15 overall statements. Table 11 shows the rating of overall statements from survey respondents. Because of the way OS_4 and OS_5 were created, a reverse ranking was developed in responses compared to the other states in numerical codes. The author reversed the results from the original data for analysis.

DBEs either agree or strongly agree with many of the overall statements. Over one hundred of the DBE survey respondents rated six statements as strongly agree. The first, there is no incentive for primes to use DBEs unless they are required by the DBE program (i.e., OS_6). Second, DBEs deliver competitive and quality products or services (i.e., OS_3). Third, the old boy network still exists and prevents DBEs from networking (i.e., OS_9). Fourth, primes are not eager to work with DBEs and reluctant to use new DBEs (i.e., OS_7). Fifth, DBEs are always able to perform work that meets project specifications (i.e., OS_5, reversed statement). Sixth, Large DBEs overshadow small DBEs making it difficult for small or new DBEs to grow (i.e., OS_10). When ranking the numbers of agreed responses, three additional statements in the top five are different compared to the strongly agreed statements. Ranked the first is that being a certified DBE increase contracting opportunities (i.e., OS_2). Ranked the third is that DBEs struggle with issues of being small, compounded with the disadvantaged status (i.e., OS_1). Ranked the fourth is that supportive services help DBEs develop their business (i.e., OS_14).

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Table 11. Rating of Overall Statements from Survey Respondents

Description	ID#	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
DBEs struggle with issues of being small, compounded with the disadvantaged status	OS_1	16	35	99	200	100
Being a certified DBE increases contracting opportunities	OS_2	23	69	69	210	81
DBEs deliver competitive and quality products or services	OS_3	5	10	62	209	166
DBEs are sometimes unable to complete work on time or schedule	OS_4	100	164	127	50	8
DBEs are sometimes unable to perform work that meets project specifications	OS_5	116	165	112	51	8
There is no incentive for primes to use me unless they are required by the DBE program	OS_6	21	59	50	139	183
Primes are not eager to work with DBEs and reluctant to use new DBEs	OS_7	15	68	100	119	150
Being a certified DBE, I will lose the protection from discrimination if I move out of (graduate from) the DBE	OS_8	26	68	139	121	96
The old boy network still exists and prevents DBEs from networking	OS_9	13	53	94	136	151
Large DBEs overshadow small DBEs making it difficult for small or new DBEs to grow	OS_10	13	74	129	124	111
The DBE program ensures nondiscrimination in the award and administration of federal-assisted contracts	OS_11	35	100	148	131	35
The DBE program levels the playing field for all enterprises	OS_12	51	140	129	106	25
Supportive services remove barriers for DBEs	OS_13	32	94	163	131	30
Supportive services help DBEs develop their business	OS_14	27	62	135	177	47
Joining associations (e.g., AGC, ASCE) has substantial benefits	OS_15	22	51	182	139	56

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Besides the statement of supportive services help DBEs develop their business (i.e., OS_14), DBEs ranked "neutral" in four other statements. First, joining associations (e.g., Associated General Contractors, American Society of Civil Engineers) has substantial benefits (i.e., OS_15). Second, supportive services remove barriers for DBEs (i.e., OS_13). Third, DBE programs ensure nondiscrimination in the award and administration of federal-assisted contracts (i.e., OS_11). Fourth, being a certified DBE, I will lose the protection from discrimination if I move out of (i.e., graduate from) the DBE program (i.e., OS_8). These statements also have relatively high responses in either disagree or strongly disagree categories.

Furthermore, the top three statements are the same in both disagree and strongly disagree. First, DBE programs level the playing field for all enterprises (i.e., OS_12). Second, DBE programs ensure nondiscrimination in the award and administration of federal-assisted contracts (i.e., OS_11). Third, supportive services remove barriers for DBEs (i.e., OS_13).

Survey responses relatively indicate that (1) DBEs are capable of performing quality work, (2) discrimination and barriers exist in DBE participation, and (3) DBE programs do not adequately ensure nondiscrimination or level the playing field for some DBEs.

Variable Clustering and Principal Component Analysis

Given the large set of factors and observations, interpolation of the data and conclusions based on this information alone is difficult. For this reason, the author decides to use both variable clustering and principal component analysis to reduce data dimensions and extract important information. The author uses only complete survey responses in the analyses.

Clustering variables

Variable clustering divides variables into four clusters for business challenges and three clusters for overall statements. Table 12 shows variable coefficients and the most representative variable (i.e., the variable with an asterisk in the front) in each cluster. Clusters 1, 5, 6, and 7 are

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in business challenges. Cluster 1, measured by five variables, is about opportunities and relationships. Cluster 5, measured by six variables, is about doing business. Cluster 6, measured by two variables, is about the use of technology and navigating the project-bidding process. Cluster 7, measured by three variables, is about racial or gender discrimination. Variables in each cluster are relatively representative with close values of variable coefficients. Clusters 6 and 7 have relatively high correlations with two and three variables, respectively.

Clusters 2, 3, and 4 are in overall statements. Cluster 2, measured by six variables, is about DBE programs and supportive services. Cluster 3, measured by six variables, is about unique DBE barriers. Cluster 4, measured by three variables, is about DBE performance and capabilities. Cluster 4 has a negative coefficient because of the reversed coding in both OS_4 and OS_5.

Table 12. Variable Coefficients and the Representative Variable in Each Cluster

Questions		Coefficients	Questions		Coefficients
Cluster 1	BC_1	0.45931	Cluster 2	OS_2	0.32938
	BC_3	0.44504		OS_11	0.43395
	BC_13	0.43952		OS_12	0.44387
	BC_15	0.40381		**OS_13**	**0.47107**
	BC_16	**0.48449**		OS_14	0.44593
Cluster 5	**BC_4**	**0.46955**		OS_15	0.29227
	BC_5	0.42822	Cluster 3	OS_1	0.35289
	BC_6	0.41241		OS_6	0.44787
	BC_9	0.40714		**OS_7**	**0.47740**
	BC_10	0.37081		OS_8	0.34596
	BC_14	0.35045		OS_9	0.44890
Cluster 6	**BC_7**	**0.70711**		OS_10	0.35626
	BC_8	0.70711	Cluster 4	OS_3	-0.43979
Cluster 7	BC_2	0.56339		OS_4	0.63094
	BC_11	**0.61753**		**OS_5**	**0.63914**
	BC_12	0.54885			

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Additionally, Cluster 6 seems to be a subset variable of cluster 1; cluster 7 seems to be a subset variable of cluster 2. Both clusters 6 and 7 need to be further investigated in the PCA. Cluster 4 also has relatively high correlations with three variables and needs to be further investigated in the PCA.

Principal components

A trial analysis combining factors from both business challenges and overall statements indicates distinctive and substantial contributing factors from each group. Therefore, the author decided to conduct PCA separately for each group to optimize data representation.

The PCA for business challenges has 369 observations and 16 factors. Figure 31 illustrates the eigenvalues and scree plot of business challenges. The first three components represent approximately 50% of the data. Each of the rest 13 components represents less than 7% of the data. The first five components have an eigenvalue greater than 1.0. Among these five, the first three components are more significant and representative.

Number	Eigenvalue	Percent	Cum Percent
1	4.7318	29.574	29.574
2	1.7341	10.838	40.412
3	1.3282	8.301	48.713
4	1.0508	6.568	55.281
5	1.0177	6.361	61.641
6	0.8993	5.621	67.262
7	0.7572	4.733	71.995
8	0.7246	4.529	76.523
9	0.6283	3.927	80.450
10	0.5956	3.722	84.172
11	0.5139	3.212	87.384
12	0.4532	2.832	90.217
13	0.4390	2.744	92.961
14	0.4281	2.675	95.636
15	0.3679	2.299	97.935
16	0.3303	2.065	100.000

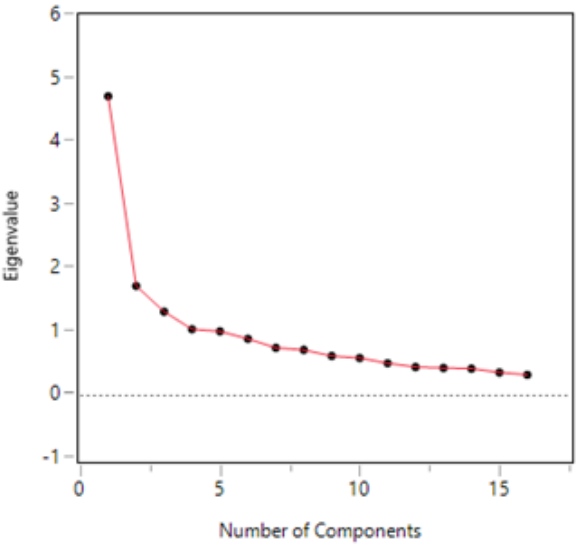

Figure 31. Eigenvalues and Scree Plot of Business Challenges

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Each principal component (PC) is a linear combination of contributing variables. Figure 32 shows the plot of the squared cosines of variables. The squared cosines show the importance of a variable to a PC. Each variable contributes to PC 1 to a degree. The variable that has the most importance in PC 1 is the bias and discrimination from prime contractors (i.e., BC_11). Then, followed by managing and maintaining the relationship with contractors, consultants, clients, subcontractors, and sub-consultants (i.e., BC_16), strong competition as a result of DBE overconcentration (i.e., BC_13), bid shopping by primes after contract award (i.e., BC_15), and diminished opportunities because of my race and gender (i.e., BC_2). PC 2 has two very important variables, including using electronic bidding and technology (i.e., BC_7) and navigating project letting and bidding process (i.e., BC_8). The most important variable in PC 3 is finding new or retaining existing skilled workers (i.e., BC_9). Then, followed by bias and discrimination from prime contractors (i.e., BC_11), getting surety bonds or increasing bonding capacity (i.e., BC_5), and diminished opportunities because of my race or gender (i.e., BC_2).

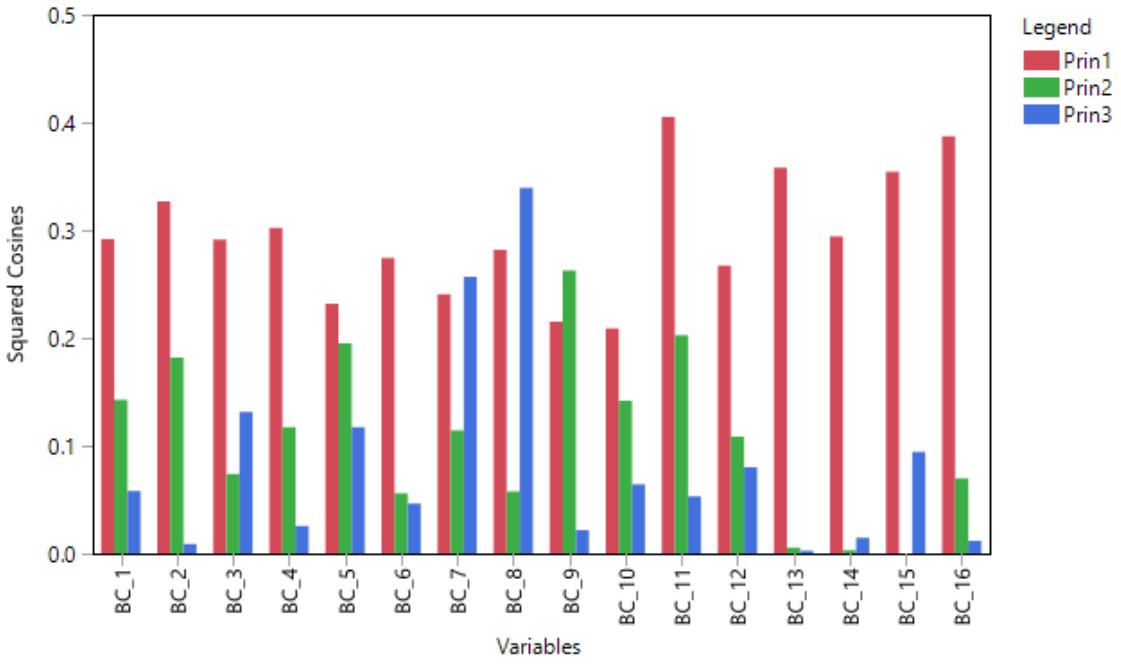

Figure 32. Squared Cosines of Variables of Business Challenges

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The PCA for the overall statement has 371 observations and 15 factors. Figure 33 illustrates the eigenvalues and scree plot of overall statements. The first three components have an eigenvalue greater than 1.0 and represent approximately 63% of the data. Each of the rest 12 components represents less than 7% of the data.

Number	Eigenvalue	Percent	Cum Percent
1	3.8801	25.867	25.867
2	3.3351	22.234	48.101
3	2.1682	14.454	62.556
4	0.9365	6.244	68.799
5	0.8501	5.667	74.467
6	0.7135	4.757	79.223
7	0.6828	4.552	83.775
8	0.6286	4.191	87.966
9	0.5191	3.461	91.427
10	0.4748	3.165	94.592
11	0.3159	2.106	96.698
12	0.2843	1.895	98.593
13	0.2115	1.410	100.003

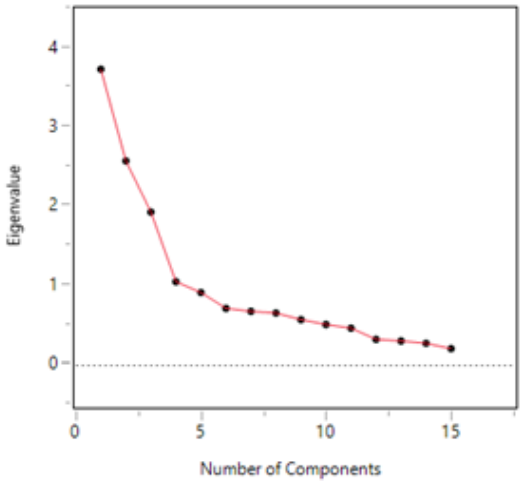

Figure 33. Eigenvalues and Scree Plot of Overall Statements

The variables OS_4 and OS_5 in the overall statements are reversed for the PCA. Figure 34 shows the squared cosines of variables. About 10 out of 15 variables contribute to the PC1 with the most important variable being the DBE program levels the playing field for all enterprises (i.e., OS_12). Then, followed by the DBE program ensures nondiscrimination in the award and administration of federally-assisted contracts (i.e., OS_11), primes are not eager to work with DBEs and reluctant to use new DBEs (i.e., OS_7), supportive services remove barriers for DBEs (i.e., OS_13), and the old boy network still exists and prevents DBEs from networking (i.e., OS_9). PC 2 has three important variables. These variables are DBEs deliver competitive and quality products or services (i.e., OS_3), DBEs are always able to complete work on time or schedule (i.e., OS_4, reversed statement), and DBEs are always able to perform work that meets project specifications (i.e., OS_5, reversed statement). These three variables are in cluster 4,

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which is about DBE performance and capabilities. The most important variables in PC 3 are that primes are not eager to work with DBEs and reluctant to use new DBEs (i.e., OS_7), A certified DBE will lose the protection from discrimination if moved out of (i.e., graduated from) the DBE program (i.e., OS_8), and there is no incentive for primes to use DBEs unless they are required by the DBE program (i.e., OS_6). These are disadvantages or barriers for DBE participation in federally assisted contracts.

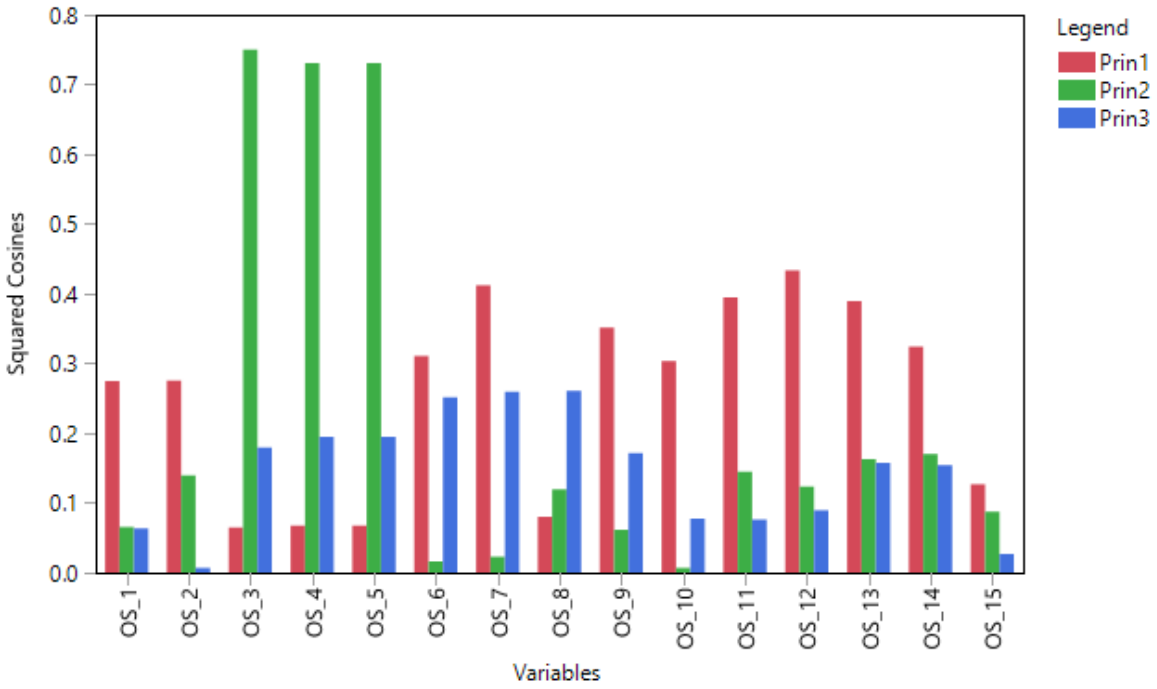

Figure 34. Squared Cosines of Variables of Overall Statements

The PCAs uncover critical information about DBE challenges. Although data rotations have not yielded any one or two components representing more than 80% or 90% of the data, the principal components still reveal a large representation and relative importance of variables. The results affirm the complexity of DBE issues and offer a structure of viewing and understanding quantitative data.

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Conclusions and Recommendations

Although the challenges of DBEs remain complex, a few patterns seem to be emerging from the analyses of quantitative data. DBEs face challenges in contracting opportunities and business relationships because of bias and discrimination from prime contractors. Lack of knowledge in navigating the project-letting process and using electronic bidding systems also creates barriers for DBEs to get contracting opportunities. Additionally, DBEs struggle with doing business in general because of being small and lacking resources (e.g., capital, workforce, and bonding). Overall, some DBEs benefit from the DBE program and supportive services, but barriers still exist for participating in federally assisted contracts. One main barrier is that primes are not eager to work with DBEs and reluctant to use new DBEs given the fact that DBEs have the capabilities to perform the contracted work.

Current DBE programs have not provided enough contracting opportunities to capable DBEs. Reasons for being that race-conscious approach increase challenges in business relationships with a high risk of regulatory violations and potential sanctions or persecutions. On the other hand, the race-neutral approach is ineffective when bias and discrimination present in federally assisted contracts. The quantitative research provides statistical evidence of challenges from DBEs and helps researchers, policymakers, DBEs, government agencies, and professional organizations understand these challenges. The understanding promotes future research and development of the DBE program. Our findings could be applied to DBEs nationwide to provide support to overcome challenges, improve the experience of DBEs, and foster economic prosperities.

Limitations and Future Research

The research is limited by the 31 variables in the quantitative study. More variables may exist that can be identified through qualitative research in the future. The scope of the study is for

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all DBEs and DBE programs but specifically for those in the transportation sector under the Federal Highway Administration. One future research is to identify state-of-the-art practices of diversity and inclusion from the private sector. Additionally, diversity and inclusion should be a part of corporate social responsibilities and ensure nondiscrimination by creating a level playing field for all enterprises.

Acknowledgments

The author thanks all research participants for completing surveys and sharing valuable insights during research interviews. The author appreciates feedback from members of the DBE technical advisory council at the Iowa Department of Transportation. The advisory council has three DBE officers, two researchers, and two DBEs.

Disclaimers

The author remains exclusively responsible for the data presented in this paper. The author claims all original work in this study, such as the creation of the survey and analyses of qualitative and quantitative data. The views and opinions expressed in this article are those of the author and do not necessarily reflect the official policy or position of any business entity or agency of the US government. The author disclaims no conflict of interest in the research.

Data Availability Statement

All data, models, and code generated or used during the study appear in the submitted article.

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CHAPTER 6. BECO FRAMEWORK FOR PROVIDING COMPREHENSIVE AND EFFECTIVE DBE SUPPORTIVE SERVICES

A paper to be submitted to the Journal of Civil Engineering Education, published by the American Society of Civil Engineering (ASCE)

Abstract

Disadvantaged Business Enterprise (DBE) program, established by the United States (US) Department of Transportation (DOT), aims to remove barriers of DBE participation, promote the use of DBEs in federally assisted contracts, and assist the development of DBEs. DBE is a small, for-profit business owned by both socially and economically disadvantaged individuals such as women or minorities. The needs of DBE supportive services depend on many factors, such as business areas, sizes, and strategies. Often, Supportive services are expensive and inefficient. This study investigates in assisting to both professional development and knowledge management of DBEs through the lens of andragogy (i.e., art and science of adult learning). The author proposed a framework for providing business, engineering, construction, and other (BECO) related supportive services to DBEs. The research used sequential explanatory mixed methods where DBEs provided both quantitative and qualitative responses to evaluate the framework. The author used confirmatory factor analysis for quantitative data and pattern coding for qualitative data. The results revealed useful supportive services in the BECO framework to DBEs in construction contracting, engineering consulting, and other business areas. The outcomes of this study improve efficiency and reduce the overall cost of supportive services.

Introduction

The Federal Highway Administration (FHWA) at the United States Department of Transportation (US DOT) allocates about $10 million funds to assist State Transportation Agencies (STAs) to accomplish the statement of work of the Disadvantaged Business Enterprise

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Supportive Services (DBE/SS) program. STAs operate the DBE/SS program in conjunction with the Disadvantaged Business Enterprise (DBE) program. The primary purpose of the DBE/SS program is to "provide training, assistance, and services to minority, disadvantaged, and women business enterprises so as to increase their activities in the program, and to facilitate the firms' development into viable, self-sufficient organizations capable of competing for, and performing on federally assisted highway projects" (US DOT 2018). Typically, an entity prepares a statement of work and provides some supportive services to assist the development of certified DBEs through identifiable and metric-based results. These supportive services include, but are not limited to, technical assistance, construction manuals, standard specifications, self-paced courses, accounting training, financial assistance, and bonding assistance.

Disadvantaged Business Enterprise (DBE) is a for-profit small business "that is at least 51 percent owned by one or more individuals who are both socially and economically disadvantaged (49 CFR. §26.5, 2014). In the case of a corporation, in which 51 percent of the stock is owned by one or more such individuals" and "whose management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it" (49 CFR §26.5, 2014). Socially and economically disadvantaged individuals include Black, Hispanic, Native, Asian-Pacific, and Subcontinent Asian Americans, as well as women or any other individuals determined on a case-by-case basis. These individuals are "subjected to racial or ethnic prejudice and culture bias in American society because of their identities as members of groups without regard to their individual qualities" and their "ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities" (49 CFR §26.5, 2014). The US DOT established a DBE program to remedy such situations and to create a level playing field for all enterprises competing on federally assisted

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contracts. The DBE program entails eight objectives under the Federal DBE regulations outlined in 49 CFR §26. Below are three of these eight objectives.

- To help remove barriers to the participation of DBEs in DOT-assisted contracts;
- To promote the use of DBEs in all types of federally-assisted contracts and procurement activities conducted by recipients;
- To assist the development of firms that can compete successfully in the marketplace outside the DBE program.

There are many ways to meet the objectives above. Often administrative assistance meets objective one. Some examples are unbundling large contracts, releasing retainage, sending prompt payment, and providing financial assistance. Outreach and networking meet objective two. Supportive services meet objective three. Some examples are courses about quantity and cost estimating, bidding process, marketing, and business development. Some argue that supportive services include administrative assistance, financial assistance, outreach, and networking. Others discuss supportive services as a part of DOT-assistance.

Literature Review

The author reviewed two literature topics: (1) art and science of adult learning and (2) state-of-the-art supportive services. Both are for a conceptual framework for supportive services. The first set an appropriate theoretical framework for developing the framework. The second provides various latent variables for constructing the framework.

Art and science of adult learning

Pedagogy was the first word representing the art and science of teaching and learning. Pedagogy often referred to teaching children and teacher-centered learning experience. Andragogy, defined by Knowles (1973) as "the art and science of helping adults learn," described different assumptions of adult learning. In the following decades, several new concepts

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emerged, including gerogogy, eldergogy, synergogy, ergonagy, heutagogy, ubuntugogy, humanagogy, anthrogogy, mesagogy, metagogy, paragogy, peeragogy, and cybergogy in Table 3. Lebel (1978) suggested gerogogy for teaching older adults compared to andragogy for teaching younger adults. Yeo (1982) similarly defined eldergogy for older adults' education. Kundson (1979) proposed a human theory of learning, humanagogy that "combines pedagogy, andragogy, and geragogy and takes into account every aspect of the presently accepted psychological theory." Courtenay and Stevenson (1983) and Rachal (1983) questioned humanagogy as a theory and concerned that gogymania in educational taxonomy. For example, Caucasiogogy could be for Caucasians in terms of race and ethnicity. Heterogogy and homogogy could be for people with different gender and sexual orientation. Infantagogy and adolescagogy could be for infants and adolescents depending on age.

Table 13. List of Different Terminology for Teaching and Learning

Terminology	Description	One of the References
Pedagogy	Art and science of teaching children	Freire, 1970
Andragogy	Art and science of teaching adults	Knowles, 1973
Gerogogy	Teaching older adults	Lebel, 1978
Humanagogy	The full spectrum of learners	Knudson, 1979
Eldergogy	Teaching older adults	Yeo, 1982
Synergogy	Learning of small groups	Mouton & Black, 1984
Anthrogogy	The full spectrum of learners	Trott, 1991
Ergonagy	Learning about workplace training	Tanaka & Evers, 1999
heutagogy	Learning beyond Andragogy, self-directed learning	Hase & Kenyon, 2000
Ubuntugogy	Education in Africa	Bangura, 2005
Cybergogy	Engaged in online learning	Wang & Kang, 2006
Mesagogy	Between pedagogy and andragogy	Laton et al., 2009
Paragogy	Peer-to-peer learning	Corneli & Danoff, 2011
Peeragogy	Peer-to-peer learning	Rheingold, 2012
Metagogy	Blended aspects of pedagogy and andragogy	McCaslin & Scott, 2012

Andragogy, defined by Knowles (1973) as the art and science of teaching adults, gained scholarly recognition during the last two decades in the United States (Davenport and

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Davenport). Andragogy is “the art and science of adult learning,” which encourages trainers to use an appropriate framework and theory in the development of training classes and workshops. Andragogy theory has six core adult learning principles including (1) learner’s need to know, (2) self-concept of the learner, (3) prior experience of the learner, (4) readiness to learning, (5) orientation to learning, and (6) motivation to learning (Knowles et al. 1998).

Owners or employees of a business enterprise have various professional development opportunities through vicarious and social learning. Myers (2015) introduced vicarious learning as “learn from other’s experiences.” Furthermore, Myers described coactive vicarious learning as learning “through collaborative, two-way interactions with others at work.” Coactive vicarious learning complement and stimulate knowledge sharing. Coactive vicarious learning takes the learning and sharing of knowledge to the next step, which is affirmation and deep understanding of knowledge. Then, practices and production of high-quality work are a consolidation of knowledge and cultivation of creativity and innovation. Social learning is another approach to professional development through mentoring and role modeling. People are social and need a mentor or a role model. Learning from other’s experiences makes knowledge sharing interesting.

Both Engineering and Construction industry should adopt knowledge management for three main reasons: 1) knowledge is well developed, 2) knowledge is repeatedly used, and 3) knowledge is generally comprehensive. Knowledge management has two primary strategies: codification and personalization (Hensen et al. 1999). Codification strategy is to “provide high-quality, reliable, and fast information-systems implementation by reusing codified knowledge.” The construction industry relies on a large knowledge dataset. A construction project cycle involves planning, design, construction, commission, operation, maintenance, termination, and demolition. A tremendous amount of knowledge is required for a project to be successfully

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delivered to the owner. Codification strategy has been widely used in the construction industry in forms of project manuals, design memos, specifications, and building codes.

There are several reasons why codification is better than personalization in the construction industry. First, knowledge is well developed in the construction industry. Before construction begins, knowledge is developed and prepared in the form of many documents such as construction documents, project specifications, budget, schedule and so forth. These documents are codified knowledge for the contractors. Document management is essential the knowledge management for the construction industry. Second, knowledge is reused many times in the construction industry. Not every project is the same, but every project uses repeatable knowledge from previous projects. If a person read and watch some masonry documents, the person can be a mason in the field following the masonry specifications and manuals. The same role applies to engineers; most engineers learn from codified documents such as textbooks, design memos, building codes, and documents from previous projects. Then, engineers take exams to be certified as a professional engineer so that he or she can sign and seal construction documents. Codified knowledge is commonly reused in the construction industry. Third, knowledge is generally comprehensive in the construction industry. A project engineer performs many tasks in the construction industry with or without an area of expertise or specialization. Therefore, a personalized or customized solution only works for unique problems and has a limited application on generalized construction practices. The construction industry relies on resources more than intellectual assets. Therefore, project management would be more important than knowledge management. Lastly, the author argues personalization strategy is more applicable to the Medicare industry where people have unique conditions and special needs. Construction companies need to adopt a codification strategy to improve knowledge sharing. The

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author has seen many companies use codification strategy in practice to improve their knowledge sharing, productivity, and quality.

State-of-the-art supportive services

Scholars provided suggestions and recommendations related to supportive services. After the inception of the DBE program, Change (1987) provided 33 suggestions in four categories to train DBEs. These four categories were finance, bonding, training and educations, and others. Later, the NCHRP published a synthesis for implementing race-neutral measures in state DBE programs. Supportive services and training were one of the measures. The report summarized five strategies below

1. Providing firms with one-on-one business reviews and/or technical assistance;
2. Providing firms with bidding assistance, such as holding mock workshops on the bidding process or providing assistance with plan reading, bidding and estimating, job costing, and writing/designing statements of qualifications;
3. Assisting firms in using technology, such as electronic bidding, website development, and conducting business over the internet;
4. Providing training classes and technical education; and
5. Providing firms with business development assistance, such as marketing and training assistance or help with business management, business plans, or financial statements.

Shrestha et al. (2015) pointed out that different DBEs needed different assistance. DBEs providing professional services needed support in marketing. DBEs in construction needed financial assistance, safe work practices, technology support, and technical training. Shane et al. (2017) specifically studied supportive services and attempted to improve the effectiveness and quality of supportive services for the Iowa DOT DBE program. After reviewing four neighboring

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states, Shane et al. summarized five current supportive services and recommended six supportive services for the Iowa DOT DBE program. These five current supportive services were DBE orientation, workshops, one-on-one consultation, financial guidance, marketing support, and mentor and protégé program. The six recommended supportive services were an introduction into the DBE program, graphic design support, website support, financial guidance, technical workshops, and partnerships (Shane et al. 2017). Additionally, most DOT DBE programs provided annual DBE conferences and networking events.

The NCHRP (2019) proposed 11 forms of state DOT assistance for the success of DBEs.

1. DBE recruitment and effective DBE certification;
2. Relationship Building;
3. Information about contract opportunities;
4. Enforcement of prompt payment requirements
5. General training
6. Individualized training and assistance
7. Individualized assistance tiled to successful DBEs
8. Providing access to capital
9. Contract goals
10. Unbundling contracts and selection of prime contractors and consultants that are friendly to small businesses; and
11. Sheltered market bidding for small contracts.

After reviewing DBE websites and searching for supportive services, the author frequently saw supportive services as DBE program introduction or orientation, technical

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training, marketing and networking, financial assistance, management consultation, and software seminars. These services are typically free or at a discounted market price for DBEs.

Research Methodology

The author used sequential explanatory mixed methods to collect both quantitative and qualitative data from DBEs. Figure 35 illustrates the research workflow for data collection and analyses. The research is conducted using andragogy as a theoretical framework.

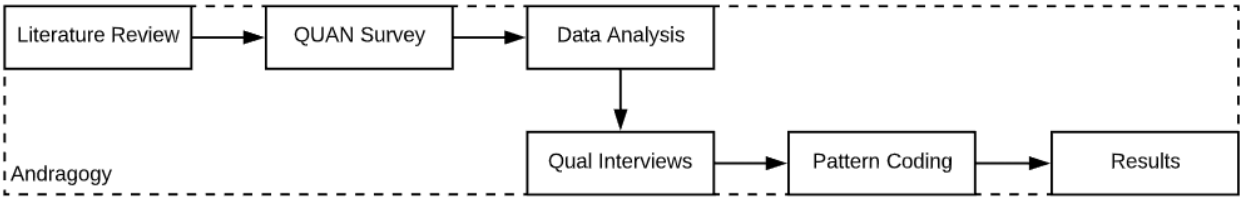

Figure 35. Research Workflow for Data Collection and Analyses

DBE surveys

The author first obtained contact information from state DOT DBE programs. Then, removed all duplicated contact information and identified 35,178 unique DBEs by the owner's name and email address. The author sent a survey to these DBEs and collected 1,384 responses between June and July of 2019. Although the response rate is low (i.e., approximately 3.4%), the number of responses is statistically significant. The survey has 26 main questions with various skip-logic and survey flows. Of the 26 questions, six questions are specifically for this study. Below is a breakdown of various questions in three sections.

Questions 1 to 8 are demographic information

Questions 9 to 16 are business information

Questions 21 to 26 are specifically for Supportive Services

Survey data is analyzed using confirmatory factor analysis (CFA) to understand if various indicators fit in each factor (i.e., latent variable). CFA is a useful technique to understand the

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structure underlying a set of measures and assess the fit between observed data and a conceptualized framework that specifies the hypothesized causal relations between latent factors and their observed indicator variables. The author specifically examines correlations of latent factors and goodness of fit statistics of various models.

DBE interviews

Based on survey responses, 54 DBEs were interested in participating in a research interview for exploring a framework for providing comprehensive and effective assistance (i.e., supportive services). The author contacted them and scheduled semi-structured interviews with 12 DBEs. Of these, ten participated and provided additional information about their survey responses and experience of using supportive services. The author decided to transcribe partially, code, and analyze the qualitative data using pattern coding. Pattern coding organizes data into sets, themes, constructs, and attributes. The author organizes data into various supportive services. Then, these data collectively support and partially validate the framework used in the survey.

Interview participants are from six states with diverse demographic information. Figure 36 illustrates the demographic information of the interview participants. Caucasian (i.e., white) women are more than half of the total, followed by black, Hispanic, and Asian Pacific Americans. The age of most interview participants is between 41 and 60. Participants have either a bachelor's or master's degree with over ten years of working experience.

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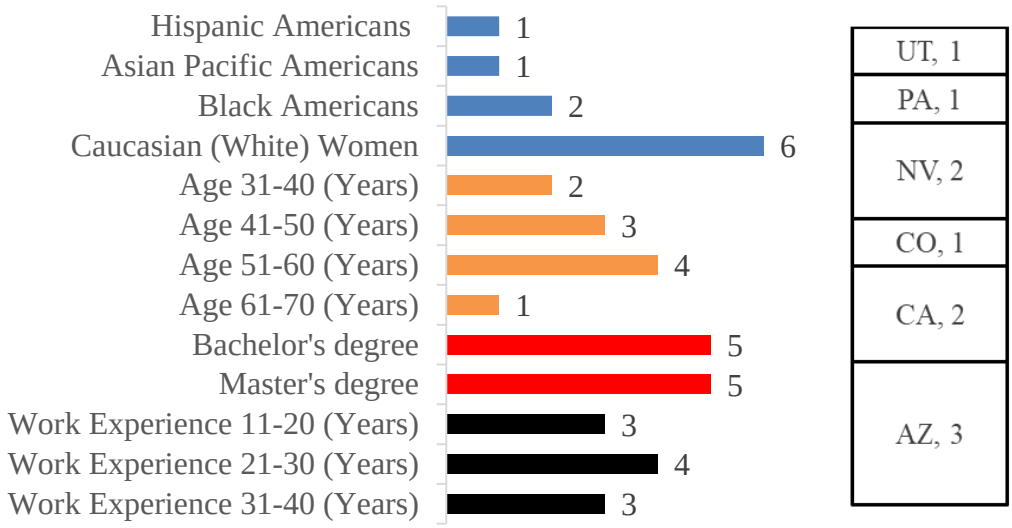

Figure 36. Demographic Information of Interview Participants

Interview participants are mostly in engineering consulting with two in construction contracting. Figure 37 shows the business information of the interview participants. Six out of ten participants have more than 10-year business ownership. Six out of ten participants have been a certified DBE for less than 10-year. Seven out of ten participants are subcontractors for less than ten times per year and have never been a prime contractor. None has been far below average in maturity or not at all successful. Both maturity and success levels are either moderately average or slightly below with a couple of DBEs in each of the upper two levels.

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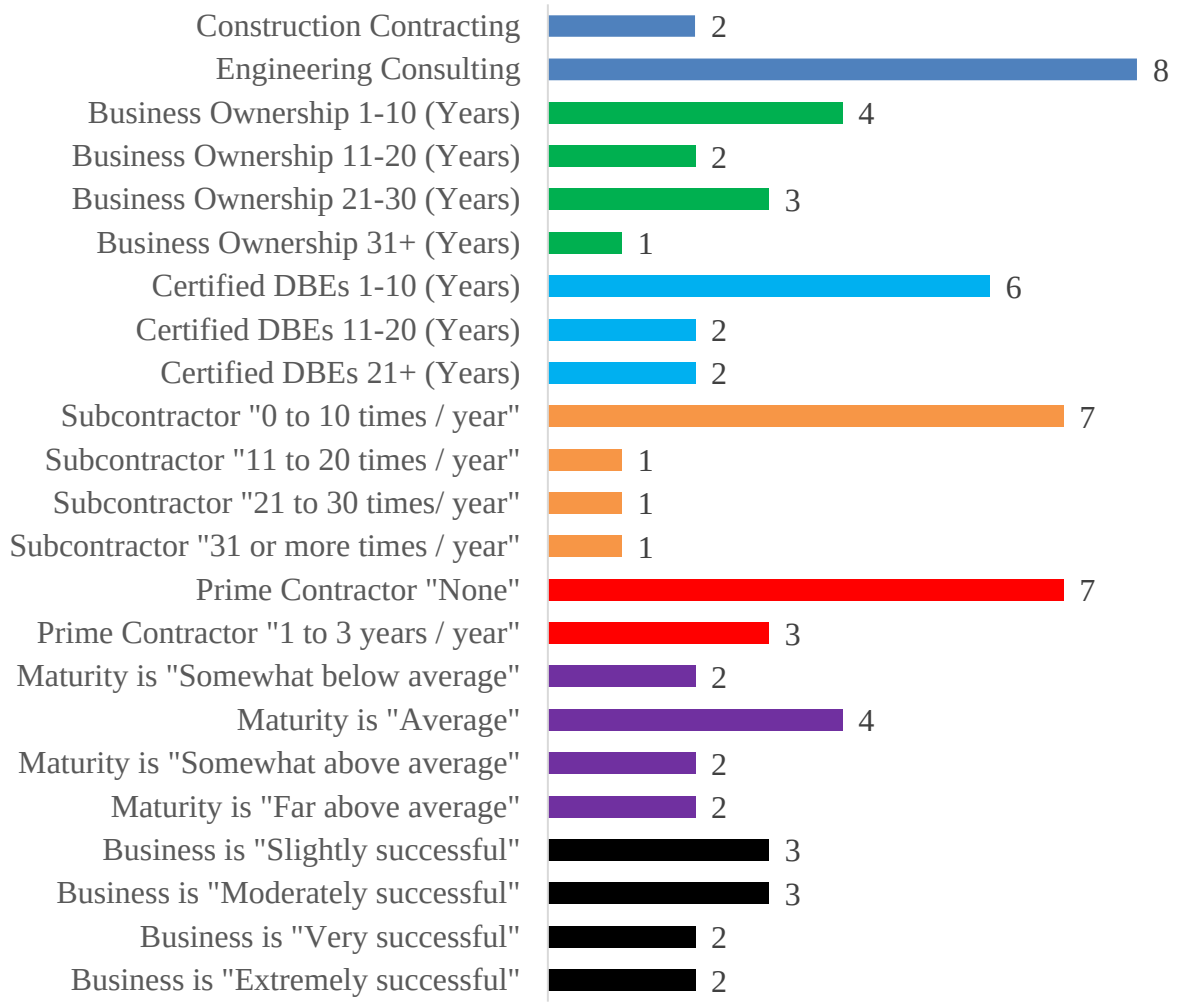

Figure 37. Business Information on Interview Participants

Proposing a BECO Framework

The author proposes developing a BECO framework to assist decisions in which types of supportive services will be the most beneficial to the DBE community. The framework includes business, engineering, construction, and other (BECO) supportive services using andragogy theory for the professional development of individuals and the knowledge management of corporations. As a rule in supportive services, the author argues that training should follow instructional design for both development and delivery. The BECO framework serves as a great tool for delivering supportive services to DBEs.

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Instructional design

Instructional design is a systematic process or practice that develop education and training programs and create a meaningful and memorable learning experience (Reiser and Dempsey 2007; Mejia 2018). A general development process for supportive services consists of six steps, 1) conducting a needs analysis, 2) exploring state of practice, 3) proposing, 4) preparing, 5) delivering, and 6) assessing supportive services. Figure 38 shows the development and delivery process for supportive services. The process follows both instructional design and andragogy framework to improve the service quality and learning experience.

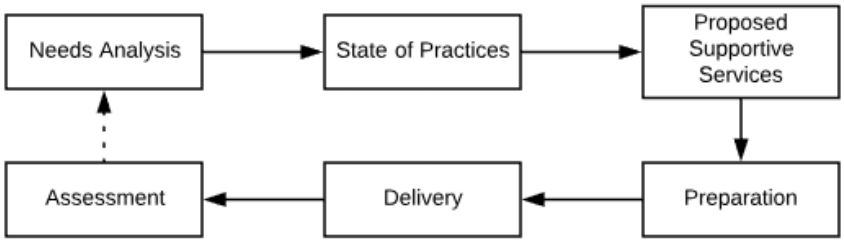

Figure 38. General Development Process for Supportive Services

The development phase consists of conducting a needs analysis, exploring the state of practices, and proposing supportive services. The delivery phase encompasses the preparation, delivery, and assessment. These supportive services include, but are not limited to, graphic design and website support, short-take videos, networking events, and offerings of training and workshops.

BECO framework

The BECO framework has four categories of relevant supportive services, including business, engineering, construction, and others. Figure 39 is a conceptual map of the BECO framework using andragogy theory for the professional development of individuals and the knowledge management of corporations.

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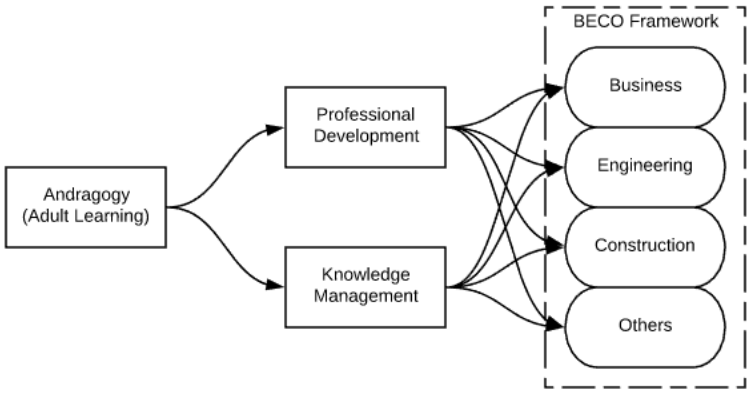

Figure 39. Conceptual Map of the BECO framework

Each category in the BECO framework has some subcategory topics. Table 14 show various key topics in the BECO framework with several indicators. Indicators are specific supportive services under each subcategory.

Table 14. Various Key Topics and Indicators in the BECO Framework

Business (33) B_1 Marketing B_2 Financial B_3 Accounting B_4 Professional Skills B_5 Operation and Management B_6 Administration B_7 Human Resources B_8 Investment	**Engineering (35)** E_1 Professional Licenses and Certifications E_2 Insurance E_3 Analysis E_4 Design by Infrastructure Types E_5 Design by Material Types E_6 Temporary Support E_7 Software and Technology E_8 Continuing Education E_9 Technical Skills
Construction (31) C_1 Bidding C_2 Bonding C_3 Safety C_4 Project Scheduling and Cost Control C_5 Contract Administration C_6 Quality Assurance and Control C_7 Jobsite Management C_8 Special Topics	**Others (19)** O_1 DBE Program Support O_2 Relevant Programs O_3 Annual Conference O_4 One-on-one assistance O_5 Tuition Reimbursement O_6 Collaboration with other organizations

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Quantitative and Qualitative Data Analyses

DBEs responded to supportive services in the BECO framework using a five-point Likert-scale with an additional option of not applicable. Because DBEs were often subcontractors with different specialties, a relatively large number of supportive services might not apply to their businesses. Although many supportive services were useful, DBEs often neither knew the existence of supportive services nor attended any activities. DBEs also indicated most supportive services were for startup companies or newly certified DBEs. These services were not useful to them since they already knew the information or had the knowledge. Because of these various experiences and perceptions, the author decided to use a filter question that only allows DBEs who would use more supportive services in the future to respond to the BECO framework, despite the fact that whether DBEs used some supportive services or not in their previous experience.

Descriptive survey results

Upon review of 448 survey responses, approximately 75% of DBEs would use more supportive services in the future regardless of whether they used some or not in their previous experience. Figure 40 shows survey responses for experience and perception of supportive services. The percentage may not total up to 100% due to round up. Approximately 24% of DBEs would not use any supportive service in the future, of which 14% have used some, and 10% never used any in their previous experience.

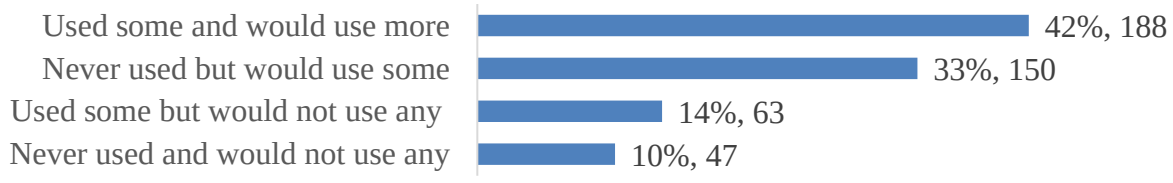

Figure 40. Experience and Perception of Supportive Services from Survey Respondents

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Some DBE owners provided reasons for never used and would not use any supportive service in the future. Common responses were never heard, not needed, or not useful or relevant to their fields. Some commented that they figured out before they used any supportive services. Few stated that supportive services were for new and inexperienced DBEs but not for experienced DBEs.

Some DBE owners provided reasons for "used some but would not use any [supportive services] in the future." Most found supportive services were not useful because of nonresponsive officers, naïve facilitators, misaligned objectives, and mismatched levels of appropriateness. One DBE owner specifically pointed out that supportive services were "too many, too broad, too disorganized, and sometimes inaccessible." Another DBE owner stated, "I have attended various seminars and 'round table' discussions. I have not found our DOT's DBE [supportive] services to be particularly helpful or even aware of the challenges small DBEs face." After attending many networking events and conferences, one DBE owner commented, "[in the conference,] [t]he primes seemed [to be] forced to be there. The DOT leaders will hardly have a useful conversation."

After DBEs chose "never used but would use some in the future," the author further asked what supportive services DBEs wanted to use. Many commented that useful supportive services would be related to networking, marketing, financial management (e.g., access to working capital or a line of credit), surety bonding, and Federal Acquisition Regulation (FAR) audits. Some DBEs indicated online services would be helpful for DBEs in remote locations. Few DBEs advocated one-on-one, face-to-face, in-person support. Additionally, DBE wanted to see more supportive services for design and engineering consultants.

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Of the 448 survey responses, 321 DBEs provided a ranking of supportive service delivery methods by impact levels (i.e., one is the most impactful and five is the least impactful). Figure 41 illustrates the impact levels of delivery methods for supportive services. The delivery method is dependent on the topic of supportive services. Most DBEs ranked the in-person classes, courses, and workshops were the most impactful delivery methods. Then, followed by online recording, in-person on-job-site training, in-person conferences, and online live streaming. Some commonly used in-person deliveries are speed-networking events, lunch-and-learn presentations, conferences, and in-person workshops and training. In-person deliveries incorporate interactions and exercises in presentations. Some topics may be adequately covered and understood through short lectures. Other topics may need to be more interactive and include a combination of lecture and exercises. In-person deliveries are usually centralized in one or a limited number of locations. Online deliveries are best suited for materials that are straight forward and do not require much interaction between the presenter and DBEs. Online deliveries are in either live or recording forms. Typically, real-time live delivery is less than one hour in duration. Although recordings do not allow interactions between the presenter and DBEs, it enables a DBE to watch the recordings at any time and go at their own pace, having the ability to start, stop, and rewind the recording.

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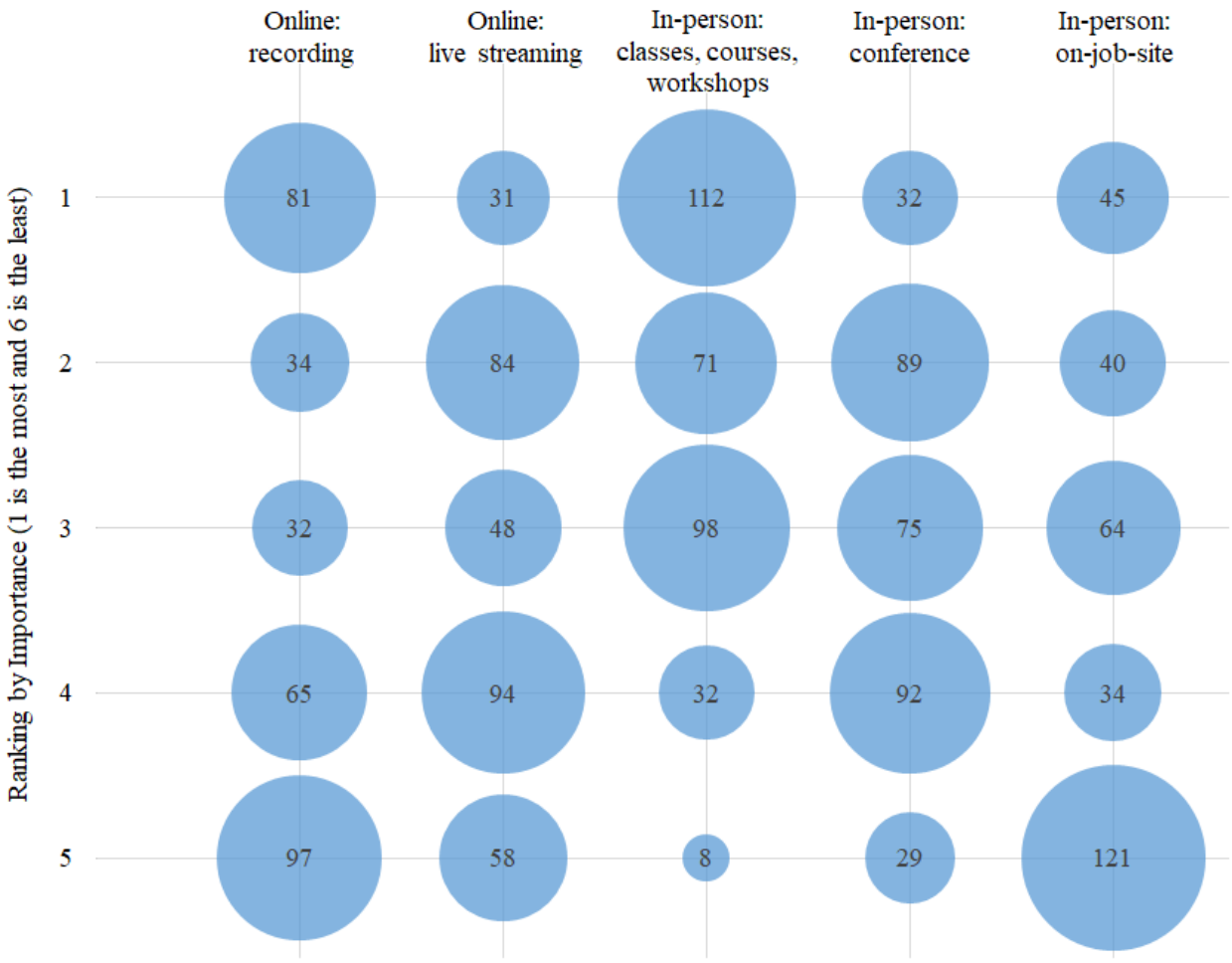

Figure 41. Impact Levels of Delivery Methods for Supportive Services

After deleting missing and incomplete data, 74, 81, and 140 DBEs in the business areas of construction, engineering, and others respectively responded to all questions related to the BECO framework. DBEs, identified as providing local trucking services, did not respond to questions related to the BECO framework. Table 15 shows the percentage of ratings from DBEs, indicating supportive services that are either very or extremely useful. The rating quantitatively reflects the usefulness of the BECO framework in three different business areas. In general, DBEs in construction rated supportive services the most useful, followed by DBEs in engineering and then DBEs in other business areas.

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Table 15. Percentage of Rating in both Very and Extreme Useful Supportive Services

ID	Construction (74)		Engineering (81)		Others (140)	
	Very useful	Extremely useful	Very useful	Extremely useful	Very useful	Extremely useful
B_1	27.64%	12.42%	24.62%	6.15%	30.41%	10.24%
B_2	30.60%	18.07%	26.26%	9.34%	30.37%	10.65%
B_3	29.53%	20.21%	31.96%	15.07%	30.43%	19.88%
B_4	28.29%	13.14%	27.41%	14.07%	26.36%	14.00%
B_5	21.54%	15.90%	25.47%	8.25%	25.42%	10.20%
B_6	23.66%	14.50%	21.71%	2.63%	21.23%	8.49%
B_7	26.44%	13.79%	31.19%	6.44%	24.15%	8.29%
B_8	25.60%	12.00%	22.52%	1.80%	18.13%	7.50%
E_1	18.71%	17.99%	18.54%	13.48%	25.93%	13.33%
E_2	14.08%	25.35%	19.66%	6.74%	19.44%	8.89%
E_3	18.18%	18.18%	21.47%	5.08%	25.17%	14.29%
E_4	16.67%	19.70%	24.39%	5.49%	17.65%	16.81%
E_5	14.02%	25.61%	19.88%	1.86%	20.97%	11.29%
E_6	10.39%	23.38%	12.68%	2.82%	19.64%	5.36%
E_7	24.85%	22.49%	28.10%	11.43%	25.84%	18.54%
E_8	19.77%	23.26%	29.54%	12.66%	14.90%	18.75%
E_9	19.05%	29.10%	29.13%	12.20%	17.61%	15.49%
C_1	30.07%	27.36%	25.94%	13.21%	14.80%	24.19%
C_2	22.69%	28.57%	19.67%	11.48%	19.32%	23.86%
C_3	30.08%	24.39%	26.09%	18.48%	19.15%	18.09%
C_4	30.95%	20.83%	31.75%	7.14%	24.22%	18.75%
C_5	30.65%	24.19%	31.25%	12.50%	21.47%	17.80%
C_6	26.16%	28.49%	26.54%	16.67%	22.28%	17.10%
C_7	23.28%	26.27%	30.80%	12.93%	17.53%	18.73%
C_8	25.52%	27.24%	23.83%	13.62%	19.82%	21.17%
O_1	29.21%	29.78%	22.20%	20.63%	22.84%	19.74%
O_2	27.52%	23.85%	16.92%	20.54%	19.13%	18.74%
O_3	21.82%	21.82%	16.67%	20.00%	23.17%	14.63%
O_4	16.98%	18.87%	18.18%	12.12%	18.00%	10.00%
O_5	43.18%	34.09%	35.42%	31.25%	38.03%	32.39%
O_6	34.55%	27.27%	25.42%	22.03%	21.51%	18.28%

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All business areas unanimously agree that tuition reimbursement (i.e., O_5) is very or extremely useful. The tuition reimbursement allows DBEs to identify and choose courses, training, or conferences that are useful to them and provide cost reimbursement to a degree. The next most useful supportive service is the collaboration with other organizations (i.e., OS_6), followed by accounting, DBE program support, contract administration, quality assurance and control, safety, and bidding. The DBE program support includes outreach and networking, email blasts and newsletters, certification assistance, DBE program introduction, financial assistance programs, unbundling large contracts, prompt pay provision, and release of retainage. The least useful supportive service is temporary support structures, followed by investment, business administration, insurance, design by material types, and one-on-one assistance.

In each business area, other supportive services are the most useful in the BECO framework, followed by supportive services in construction, business, and engineering. Besides tuition reimbursement, DBEs in construction rated top useful supportive services in collaboration with other organizations, DBE program support, bidding, contract administration, quality assurance and control, and safety. DBEs in engineering rated top useful supportive services in collaboration with other organizations, accounting, safety, contract administration, and job site management. Other DBEs rated top useful supportive services in accounting, software and technology, bonding, project scheduling and cost control, and DBE program support. Besides temporary support structures as the least useful supportive services for all DBEs, DBEs in construction rated the least useful supportive services in one-on-one assistance, business operation and management, investment, and all support services in the engineering category. DBEs in engineering rated the least useful supportive services in design by material types,

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investment, and business administration. Other DBEs rated the least useful supportive services in investment, one-on-one assistance, insurance, and business administration.

Confirmatory factor analysis

Confirmatory Factor Analysis (CFA) analyzes the fit of observed indicators to the latent factors. Figure 42 illustrates a conceptual analysis of the CFA model. Observed indicators measure each latent factor. Then, latent factors correlate with each other. The goodness-of-fit indices show the fit of the measurement model.

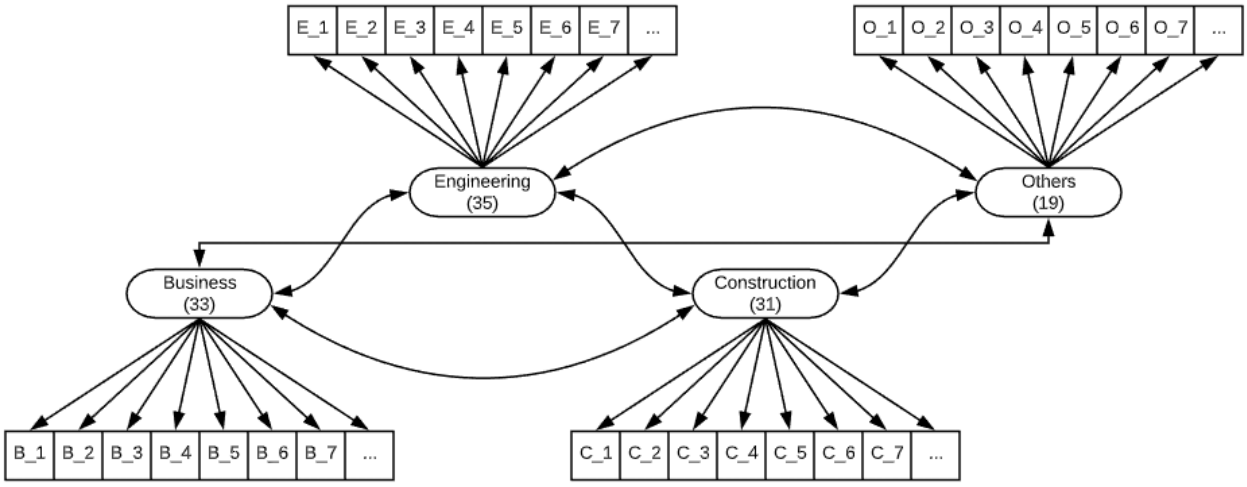

Figure 42. Confirmatory Factor Analysis of the BECO Framework

The author used the "lavaan" package (i.e., lavaan 0.6-4) in R, an open-source statistical software, to conduct the CFA. The author fitted indicators to each factor and then combined these factors in a model. Table 16 shows the correlations of factors: business, engineering, construction, and others. These factors have a moderate positive relationship with each other. The business has a relatively higher correlation with engineering and construction than others do. Engineering, construction, and others have a relatively high correlation, especially engineering and construction, with a 0.583 correlation.

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Table 16. Correlations of Factors

Correlation	Business	Engineering	Construction	Others
Business	1.000	0.399	0.392	0.276
Engineering	0.399	1.000	0.583	0.488
Construction	0.392	0.583	1.000	0.503
Others	0.276	0.488	0.503	1.000

One factor CFA model is fitted for each factor, including business, engineering, construction, and others. Then, four-factor is fitted in one CFA model. The goodness-of-fit indices include comparative fit index (CFI), Trucker-Lewis index (TLI), root-mean-square error of approximation (RMSEA), and standardized root mean square residual (SRMR). A high value of CFI and TLI indicates a good fit. A low value of RMSEA and SRMR indicates a good fit. In general, the CFA models fit well in each factor and the combined factors.

Semi-structured interviews

The author asked an open question after each category of the BECO framework. Research participants provided both positive and negative comments. Because the responses to open questions were similar to qualitative from semi-structured interviews, the author decided to combine them in pattern coding analysis and results reporting below.

Several responses attributed to lack of supportive services such as “never heard of any supportive services” or “Most of these supportive services were never offered.” Several DBEs commented that contract enforcement and advocate from DBE liaison officers were crucial to doing business. Another DBE added that a DBE liaison officer assisted the DBE when a prime contractor was “bullying” the DBE.

Some DBEs received no supportive services except going to networking events or meetings. These DBEs stated that networking was ineffective and useless because of no contracting opportunities. DBEs suspected that prime contractors already had relationships with

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existing DBEs, tried to show good faith efforts to meet regulatory requirements but was reluctant to (sometimes had no intention to) work with DBEs that they did not know.

Some DBEs found the DBE program vitally helpful. One DBE commented that the DBE program is "one of the most important factors that advanced my business this year by gaining valuable partnerships and relationships." Another DBE stated that being a certified DBE for 19 years and "LOVE this program."

Discussions and Conclusions

This chapter proposed a BECO framework for providing comprehensive and effective supportive services to DBEs. The framework provides a fundamental structure and a comprehensive guide for offering supportive services in business, engineering, construction, and other categories. Additionally, the national DBE survey identified the most and least useful supportive services in construction contracting, engineering consulting, and other business areas. The results inform DBE liaison officers and DBE supportive service providers to offer the most useful support depending on the demographics of DBEs in each state or local area.

Both quantitative survey and qualitative interview data infer that some supportive services are useful to DBEs, but more are necessary with critical refinement. Most supportive services are at introductory levels, which are useful to newly certified DBEs that are small. DBEs certified for a while or relatively developed are lack of effective support from both DBE programs and supportive service programs. Because of this, DBEs rarely able to compete successfully in the marketplace outside the DBE program.

DBEs needed different supportive services at various sizes and in different areas. The author proposed a framework to provide business, engineering, construction, and other related supportive services to DBEs. Useful supportive services are listed below.

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1. All business areas unanimously agree that tuition reimbursement is very or extremely useful.
2. Useful supportive services for DBE in construction contracting are the collaboration with other organizations, DBE program support, bidding, contract administration, quality assurance and control, and safety.
3. Useful supportive services for DBE in engineering consulting are the collaboration with other organizations, accounting, safety, contract administration, and job site management.
4. Useful supportive services for other DBEs are accounting, software and technology, bonding, project scheduling and cost control, and DBE program support.

Although providing all supportive services in the BECO framework is expensive and likely exceeds the available budget, the framework still can serve as a comprehensive guide for conducting a needs analysis, creating an assessment, collecting measurements, and evaluating instructions.

Limitation and Future Research

The survey results are limited to voluntarily responded DBEs with limited qualitative information. Although, supportive services vary significantly from different states for different DBEs, the BECO framework provides a point of departure for providing supportive services to new and emerging DBEs. Well-developed and matured DBEs need specific assistance that may or may not be in the framework, which needs additional needs analysis, measurements, and future research.

Future research should focus on integrating the BECO framework with business integrated development models to provide effective assistance at various levels of business

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development. Additionally, a curricula instrument should be developed based on the integration for assessing and providing supportive services that are specific and useful.

Data Availability Statement

Some or all data, models, or code generated or used during the study are proprietary or confidential in nature and may only be provided with restrictions (e.g., anonymized data). Data will be permanently deleted upon completion of the research study.

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CHAPTER 7. FRAUD AND ABUSE SCHEMES IN THE DISADVANTAGED BUSINESS ENTERPRISE PROGRAM

A paper to be submitted to the Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, published by the American Society of Civil Engineers (ASCE)

Abstract

The Office of Inspector General has recently investigated many fraud cases in the disadvantaged business enterprise (DBE) program of the United States Department of Transportation (US DOT). The DBE program was established by the US DOT in 1983 to provide an opportunity for those who would normally be at a disadvantage and ensure nondiscrimination for DBEs. A DBE is a small, for-profit business that is at least 51% owned and controlled by both socially and economically disadvantaged individuals such as women or minorities. Pervasive fraud and abuse cases have serious consequences, such as diminishing opportunities for legitimate DBEs, increasing resources spent on fraud investigations, and diverting federal funds from intended purposes. This paper describes an analysis of DBE fraud and abuse cases. It finds that the most common DBE fraud schemes include DBE fronts for non-DBE businesses and pass-through schemes. This paper suggests mechanisms for improving existing DBE fraud-prevention and enhancement mechanisms through the use of combined databases and educating project participants and enforcement personnel with fraud-detection and prevention training programs.

Keywords: Fraud and Abuse Cases; Disadvantaged Business Enterprise (DBE); Fraud Schemes

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Introduction

"DBE [Disadvantaged Business Enterprise] fraud is pervasive in the construction industry, and persons so inclined to commit the same kind of fraud need to be aware that they face serious consequences from DBE fraud," stated Judge Sylvia H. Rambo in handing down the sentence for the largest Disadvantaged Business Enterprise (DBE[1]) fraud in the nation's history (US Department of Justice 2014). This fraud, committed by Marikina Construction Corporation and Schuylkill Products, Inc., involved 339 construction contracts totaling up to $136 million over 15 years. In 2014, the Court sentenced five individuals complicit in the case to imprisonment for 2 to 7 years and also ordered them to pay $119.4 million in restitution (US DOT Office of Inspector General 2019).

In 1980 under the authority of Title VI of the Civil Rights Act of 1964, the United States Department of Transportation (US DOT) established a minority business enterprise program. The name of the program was changed to the DBE program in 1983 under the Surface Transportation Assistance Act (STAA)[2]. This Act requires that "not less than 10 per centum of the amounts authorized to be appropriated under this Act shall be expended with small business concerns owned and controlled by socially and economically disadvantaged individuals." Since its inception, Congress has reauthorized the DBE program another five times through the following (US DOT 2018):

- Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), Pub. L. 102-240, Stat. 1914
- Transportation Equity Act for the 21st Century "TEA-1" - 1998 (Sec. 1101)

[1] A DBE is a for profit, small business owned and controlled at least 51% by both socially and economically disadvantaged individuals such as women, minorities, or others designated by the Small Business Administration.
[2] Public Law 97-424 Sec. 105(f)

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- Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users "SAFETEA-LU" – 2005 (Sec. 1101)
- Moving Ahead for Progress in the 21st Century Act "MAP-21" – 2012 (Sec. 1101)
- "Fixing America's Surface Transportation Act" or the "FAST Act" (P.L. 114-94, Dec. 4, 2015)

According to the Code of Federal Regulations (CFR) as delineated in 49 CFR Part 26, there are seven groups recognized as disadvantaged including Black, Hispanic, Native, Asian-Pacific, and Subcontinent Asian Americans, as well as Caucasian (i.e., white) women and any other groups designated as both socially and economically disadvantaged by the Small Business Administration (SBA). This part of the Code of Federal Regulations describes eight objectives of the DBE program. Two of these are to (1) narrowly define DBE program eligibility via applicable law and (2) ensure that only firms that are fully meeting the eligibility standards are permitted to participate as DBEs in federally assisted contracts. Other objectives include ensuring nondiscrimination, providing an opportunity to those who may normally be at a disadvantage, removing barriers to participation, and assisting in DBE firm development[3] to enable their participation in federally assisted contracts. Since the DBE program's inception, fraud and abuse have emerged and increased over the years, creating a substantial misrepresentation of and a destructive environment for DBEs.

[3] The 49 CFR Part 26 for highway and transit has eight objectives compared to six objectives in the 49 CFR Part 23 for aviation. The two additional objectives are (1) to promote the use of DBEs in all types of federally assisted contracts and procurement activities conducted by recipients and (2) to assist the development of firms that can compete successfully in the marketplace outside the DBE program. The Federal Highway Administration allocates up to $10 million annually for DBE supportive services program to accomplish similar objectives.

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Literature Review

The literature related to DBEs consists of legal cases and reviews, government audits and reports, public commentaries and news, and scholarly studies from a variety of disciplines including the fields of transportation, construction engineering and management, political science, public administration, and economy. Each contributes to the final rulemaking and contemporary evolvement and improvement of the program. Table 17 shows the effective dates of DBE final rules in the Code of Federal Regulation (CFR). Literature before the most recent DBE final rule of November 3, 2014, was issued may contain obsolete information. However, the earlier literature contains information critical to the DBE fraud and abuse cases that have ensued. The author has therefore selectively reviewed literature prior to the 2014 final rule from the US Government Accountability Office (GAO), the US DOT's Office of Inspector General (OIG), and the Transportation Research Board (TRB) National Cooperative Highway Research Program (NCHRP) if it was found to still be relevant or impactful to current cases.

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Table 17. Effective Dates of DBE Final Rules

Effective Date		Final Rule Date	DBE Regulations	Action
1983	**August 22**	**July 21**	**49 CFR Part 23**	**Final rule**
1992	**June 1**	**April 30**	**49 CFR Part 23**	**Final rule**
		October 6, 1993	49 CFR Part 23	NPRM
		May 30, 1997	49 CFR Part 23 and 26	SNPRM
1999	**March 4**	**February 2**	**49 CFR Part 23 and 26**	**Final rule**
	June 28	**June 28**	**49 CFR Part 23 and 26**	**Final rule; correction**
		August 29, 2000	49 CFR Part 26	Inflation adjustment
		September 8, 2000	49 CFR Part 23 and 26	SNPRM
2000		**November 15**	**49 CFR Part 26**	**Interim final rule**
		May 8, 2001	49 CFR Part 26	NPRM
2003	**July 16**	**June 16**	**49 CFR Part 26**	**Final rule**
2005	**April 21**	**March 22**	**49 CFR Part 23**	**Final rule**, SNPRM
2007	**May 2**	**April 2**	**49 CFR Part 23 and 26**	**Final rule**
2009	**April 3**	**April 3**	**49 CFR Part 23 and 26**	**Final rule**
		April 8, 2009	49 CFR Part 26	ANPRM, NPRM
2010	**April 1**	**April 1**	**49 CFR Part 23**	**Final rule**
		May 10, 2010	49 CFR Part 26	NPRM
2011	**February 28**	**January 28**	**49 CFR Part 26**	**Final rule**
2012	**July 20**	**June 20**	**49 CFR Part 23**	**Final rule**
		September 6, 2012	49 CFR Part 26	NPRM
2014	**November 3**	**October 2**	**49 CFR Part 26**	**Final rule**

In 1988, the US GAO released a report reviewing DBE programs under the Federal Highway Administration (FHWA) and assessing fraud and abuse of the program in highway contracting. The report outlined a total of 179 DBE fraud investigations, including 89[4] nationwide cases investigated by the Office of Inspector General (OIG), 66[5] investigated by the New York (NY) DOT, and 24[6] by the Pennsylvania (PA) DOT. From the 89 cases investigated

[4] A total of 70 cases closed with 53 from administrative actions and 17 from judicial actions. Of the 53 cases, 32 had no action and 21 had various administrative sanctions.
[5] A total of 49 cases closed from administrative actions with 26 had no action and 23 had various administrative sanctions.
[6] A total of 12 cases closed with 11 from administrative actions and one from judicial action. Of the 11 cases, six had no action and five were decertified from the DBE program.

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by the US DOT OIG, 17[7] were prosecuted, resulting in $1,040,434 in fines and restitution from contractors. Of the 66 cases investigated by the NY DOT, only one was prosecuted, and five DBEs were decertified through administrative sanctions. Outcomes of the 24 cases investigated by the PA DOT include 15 DBEs being decertified, three suspended, and five debarred. The report described businesses awarded a total of $5.3 billion in federal aid highway contracts that, in fact, "(1) are ineligible to be DBEs, but obtained certification and obtained contracts based on inaccurate or misleading information, or (2) meet the minimum eligibility criteria, but engage in questionable contractual arrangements with other [ineligible] contractors." Several of these schemes were (1) DBEs controlled by non-disadvantaged (i.e., ineligible) individuals, (2) "bogus businesses" existing only on paper and allowing ineligible individuals to obtain benefits, (3) DBEs serving as middlemen or as a "broker" between prime contractors and subcontractors, and (4) DBEs functioning as a "front" with paid monetary compensation by the non-DBE prime contractor. To prevent fraud, state-required minimum procedures for DBE certification include (1) interviewing all applicants, (2) visiting the applicants at work locations, (3) analyzing various technical and financial documents such as lease agreements and partnership agreements, and (4) reviewing the resume of the principal owners of applicant firms.

Since 1983, the US GAO has released other reports on the impact of the DBE program and enforcement of DBE program policies. Many of these reports have little or no information about DBE fraud and abuse and thus are not reviewed in detail in this paper.

In 2007, the TRB NCHRP released the web-only document 120: "A survey of state practices for protecting transportation agencies against construction and disadvantaged business enterprise fraud including use of contractor suspension and debarment procedures." This

[7] The 17 cases were a part of 89 cases investigated by OIG. Of the 17 cases, 12 resulted in convictions and five resulted in acquittals.

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document, based on survey responses from 17 states, reviewed DBE fraud in construction contracts under the False Claims Act[8]. The document quoted remarks at the 2004 National Fraud Awareness Conference from the US DOT Inspector General Kenneth Mead that, between 2000 and 2004, the "US DOT has had 131 indictments, 96 convictions, and over $73 million in fines, restitution, and other recoveries of DBE fraud." Additionally, Kenneth stated, "Today, fraud in highway and transit programs is increasingly sophisticated and crosses geographic boundaries, which is precisely why effective prevention, detection, and prosecution is achievable only through a well-coordinated, multi-disciplined, and intergovernmental approach." Some typical schemes outlined in the TRB document were (1) DBEs serving as fronts, (2) false claims for work never performed, work performed less than claimed, and work performed by others (i.e., by non-DBEs), and (3) obtaining certifications by forged documents. Although the NCHRP report provided some evidence of DBE fraud, due to its very limited data in terms of the number of survey responses and other available information, it could neither quantify DBE fraud nor fully assess the magnitude of the problem (NCHRP 2007).

The US DOT OIG has reported DBE fraud over the last two decades in semiannual reports to Congress. Examples include a DBE construction firm from Ohio in 1998 serving as a front for work performed by non-DBE contractors. The prime contractor connected with the scheme was fined $500,000, and both firms were sentenced to 3 years' probation. In 2000, the

[8] The False Claims Act, enacted in 1863, uses qui tam action as the primary enforcement method to recover billions of taxpayers' dollars stolen by contractors every year. Qui Tam is the Latin phrase 'Qui Tam pro domino rege quam pro se ipson in hac parte sequitur', which means 'who pursues this action on our Lord the King's behalf as well as his own,' Vermont Agency of Natural Resources v. US ex rel. Stevens, 529 US 765, 769, 120 S. Ct. 1858, 1860, 146 L. Ed. 2d 836 (1999) n.1 (2000) (citing 3 W. BLACKSTONE, COMMENTARIES ON THE LAW OF ENGLAND 160 (768)). A "Qui Tam" action is an action brought under a statute that allows a private person (informer or relator) to sue for a penalty, part of which the government or some specified public institution will receive or share with the relator. Under the FCA, the Attorney General will investigate the claim and take one of three courses of action: (1) join the government to the suit as a party; (2) decline to join and allow the private party to continue; or (3) decline to join and block the suit. 31 USC §3730.

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OIG issued a verdict against another DBE acting as a front for a non-DBE in relation to five highway projects with more than $747,000 in contract value. In the following years, as the number of recognized DBE fraud cases increased, the OIG increased its effort in DBE fraud investigation in response. In 2004, the Inspector General, Kenneth Mead, listed the DBE program as one of the US DOT's top management challenges. The report summarized, "The DBE program suffers from a high level of fraud and abuse, as well as significant gaps in the Department's oversight. We are currently investigating 40 DBE fraud schemes in 19 states." An investigation of the DBE program in New Orleans found many illegal DBE fronts, false certifications, and a widespread misconception that political patronage affected the awarding of DBE contracts. Other issues identified include false certifications obtained by DBE owners whose personal net worth exceeded the program limit; DBE businesses controlled, in fact, by non-minorities; failure to submit annual affidavits; and unconducted site visits. The 2007 OIG report discussed DBE fraud associated not only with false DBE fronts but also false claims, kickbacks, bribery, and corruption.

The OIG has produced 12 different fraud awareness cards[9] to increase workplace awareness and thereby help prevent and detect fraud in DOT programs. These cards include common fraud schemes beyond DBE fraud, such as conflicts of interest, bid-rigging, bribery, kickbacks, materials overcharging, time overcharging, product substitutions, quality control testing, debris removal fraud, household good moving fraud, and general fraud. Each card defines the scheme and lists the "Red Flag" indicators. All cards have the OIG fraud hotline and complaint information, including contact form URLs, phone and fax numbers, and email and

[9] Electronic versions of cards (e.g., PDFs) are available on the OIG website: https://www.oig.dot.gov/investigations/common-fraud-schemes

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mailing addresses. The definition from the OIG's fraud awareness card of a DBE fraud scheme along with its "Red Flag" indicators are listed below.

Definition—

DBE Fraud[10]: Under this scheme, a contractor misrepresents who performed the contract work in order to increase job profit while appearing to comply with contract goals for the involvement of minority- or women-owned business.

"Red flag" indicators—

- DBE owner lacking background, expertise, or equipment to perform subcontract work
- Employees shuttling back and forth between a prime contractor and DBE-owned business payrolls
- Business names on equipment and vehicles covered with paint or magnetic signs
- Orders and payment for necessary supplies made by individuals not employed by DBE-owned business
- Prime contractor facilitated the purchase of DBE-owned business
- DBE owner never present at the job site
- Prime contractor always uses the same DBE
- Financial agreements between prime and DBE contractors
- Joint bank accounts (Prime/DBE)
- Absence of written contracts

In 2013, the US DOT OIG again released a report[11] criticizing several weaknesses, increasing the risk of fraud, waste, and abuse of the DBE program. These weaknesses are

[10] An electronic version (i.e., PDF) of the DBE fraud card is available on the OIG website: https://www.oig.dot.gov/sites/default/files/files/OIG_DBE%20card.pdf.
[11] The report title is "Weaknesses in the department's disadvantaged business enterprise program limit achievement of its objectives".

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inconsistent certification practices, insufficient oversight of DBEs at job sites, inadequate staff for the DBE program, and lack of standard departmental guidance and effective practices. The report highlighted that DOT distributed over $4 and $3 billion to DBEs in fiscal years 2009 and 2010, respectively. Most recently, the FAST Act allocated approximately $50 billion each year towards highways between the fiscal year 2016 and 2020, with 10% (i.e., $5 billion) expended with 41,000 DBEs nationwide. For instance, California awarded approximately $2.4 billion with an overall 12.5% DBE goal in 2018. California DOT achieved 14.03% DBE goal, equivalent to $342 million in contracted work. Similarly, Texas DOT awarded $3.8 billion contract work with an overall 12.6% DBE goal. The increased federal funds in highway construction put the DBE program and its fraud investigations at an imperative position.

Research Methodology

Previous reports criticized the US DOT as not having a systematic process of collecting and compiling information on DBE fraud investigations (US GAO 1988, US GAO 2001, NCHPR 2007). The resulting inconsistent and anecdotal information has made additional research time-consuming and challenging to arrive at definitive conclusions. Additionally, research data collection is difficult for DBE fraud and abuse cases because of its close ties to legal investigations and sensitive information. The author followed the research process illustrated in Figure 43 and analyzed two national databases, conducted nine unstructured interviews, and completed three case studies. The analysis of these qualitative and quantitative data identifies the most common schemes of DBE fraud.

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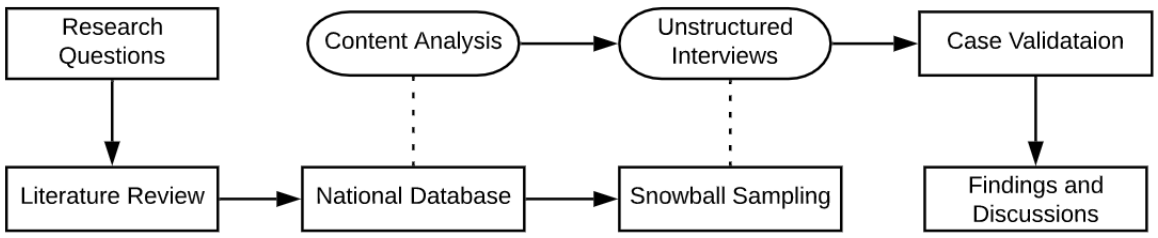

Figure 43. Research Design and Workflow for DBE Fraud and Abuse Schemes

The first national database is from the US DOT Departmental Office of Civil Rights (DOCR) and allows search for decertified DBEs, denials, and DBE appeal decisions. This database contains thousands of DBE decertification, denials, and appeal decisions from 2009 to 2019. The second database covers US DOT OIG investigations and semiannual reports to Congress, including DBE fraud investigations from 1998 to 2019. The OIG receives many, but only accepts some, referred investigations, so this database represents only a small portion of the DBE fraud cases nationwide and does not include investigations handled by states without the OIG's involvement. DBE fraud cases are difficult to investigate due to increasingly sophisticated schemes. The OIG database, therefore, contains hundreds of DBE fraud cases that typically have substantial evidence on large federally assisted highway projects and a high dollar recovery.

The author conducted nine unstructured interviews with each from the states of California, Arizona, Louisiana, Georgia, District of Columbia, New Jersey, South Carolina, Illinois, and Florida. The author uses a snowball sampling strategy to ask research participants to refer others to participate in the research. A snowball sampling strategy is suitable to collect data from groups that are difficult to reach or identify. The author finds a subject and asks the subject to nominate further subjects to participate in the research. The sample size increases like a rolling snowball. In the course of researching a related study, the author conducted a national DBE survey. Because of their interest, this work prompted some DBEs to contact and discuss fraud and abuse through unstructured interviews. There is a significant risk of bias in snowball

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sampling. However, the author triangulates data with information from both of the national databases.

Data Collection and Analysis

The US DOT DOCR manages the federal DBE program as well as oversees state and local DBE programs. This DBE program certifies DBEs based on the eligibility criteria prescribed by the latest DBE final rule in 2014. Understanding the latest DBE final rule's definitions and requirements is critical to ensure only DBEs fully meeting these criteria are permitted to participate in the program on federally assisted contracts. The latest DBE final rule limits eligibility by the following criteria[12]:

1. The owner(s) of the DBE must:
    a. Be individuals from both socially and economically disadvantaged groups
    b. Have a personal net worth of less than $1.32 million
2. A certified DBE must:
    a. Be at least 51% owned by individuals who are both socially and economically disadvantaged
    b. Be an independent business for which the owners control the management and operation of the business
    c. Have a three-year average revenue[13] of less than $23.98 million.
    d. Complete certification requirements and periodically (e.g., annually) submit an affidavit of no change in ownership status or revenue.

[12] Criteria are from the latest DBE final rule. Some criteria had minor changes such as women became one of the disadvantaged group in 1987, dollar values were adjusted for inflation, and additional procedures were added and information was required for certification and reassessment.

[13] Some argue if a DBE must qualify as a small business under size standards set forth in the SBA. The standards usually define the maximum size by the number of employees or the average annual revenue. Some small businesses providing professional services may have a limit less than the specific limit of $23.98 million by the US DOT DBE program.

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e. Perform a commercially useful function[14].

The US DOT DOCR database shows over 10,000 DBE decertification and denial records with thousands of appeal decisions dated between 2009 and 2019. The database offers multiple search criteria including company name, owner's first name, owner's last name, decision (i.e., denial, decertification, and proposed decertification), state, application type (i.e., DBE and ACDBE), and date range. A typical record consists of further information such as decision (i.e., decertification or denial), date, unified certification program (UCP) state, appeal (i.e., yes or no), decision-rendering UCP, and reason. Some records list other reasons for the decision in addition to those listed under "reason."

At the time of sampling, the database contained 2,372 DBE denials from January 2009 to January 2019. Figure 44 shows the number of denials from each state. The number of denials is relatively proportional to the total number of certified DBEs in a state. The top five states accounting for approximately half of the total denial decisions are California, Ohio, Illinois, New York, and Tennessee. California received approximately 22% of the total DBE denials. The other four states received from 5% to 10% of the denials, respectively. All other states share the other half of DBE denial decisions ranged from receiving 0% to 4.5% of the total.

[14] The 49 CFR §26.55 describes the commercially useful function. A DBE performs a commercially useful function when it is responsible for execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. Although some technical assistance from other contractors to DBEs is acceptable, DBEs are expected to supervise their own employees at work locations and make all management decisions.

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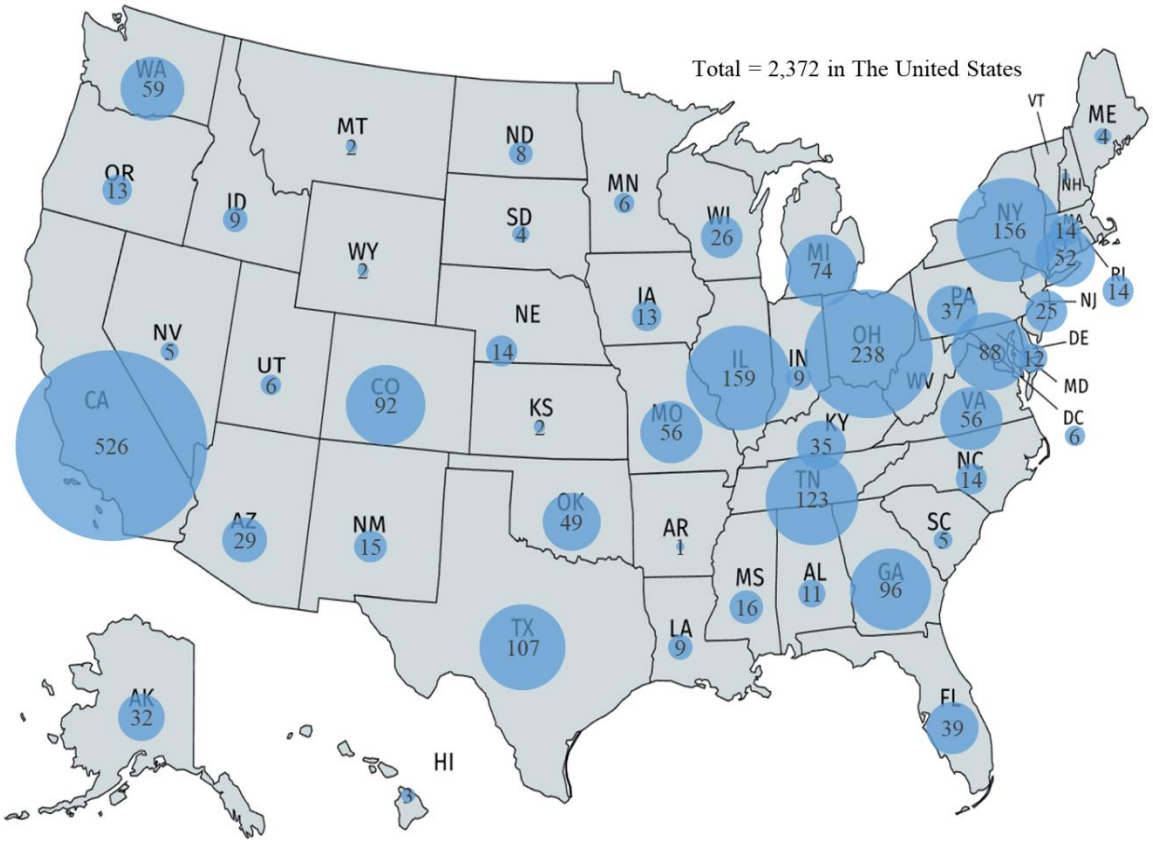

Figure 44. Numbers of Denied DBE Certification between 2009 and 2019

The primary reasons for denials ranging from the most to the least common are

(1) the firm is not owned and controlled by socially and economically disadvantaged individuals,

(2) failure to cooperate with recipient requests for information or being nonresponsive,

(3) lack of expertise or independency to perform contracted work,

(4) exceeding limits of personal net worth or three-year average revenue,

(5) uncertified in the home state in the interstate certification, and

(6) voluntarily withdrawal from the DBE program.

Additionally, the database reports 8,007 DBE decertification from January 2009 to January 2019. Figure 45 shows the number of decertification from each state. The top four states are California, Texas, New York, and Massachusetts. California again has approximately 25% of

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the total. The number of decertification received by the other three top states ranged from 5% to 8% each. Combined with the 5.76% of the decertification issued to the District of Columbia, these top states again account for approximately half of the total number of decertification issued. All other states share the other half ranged from receiving 0% to 4% of the total.

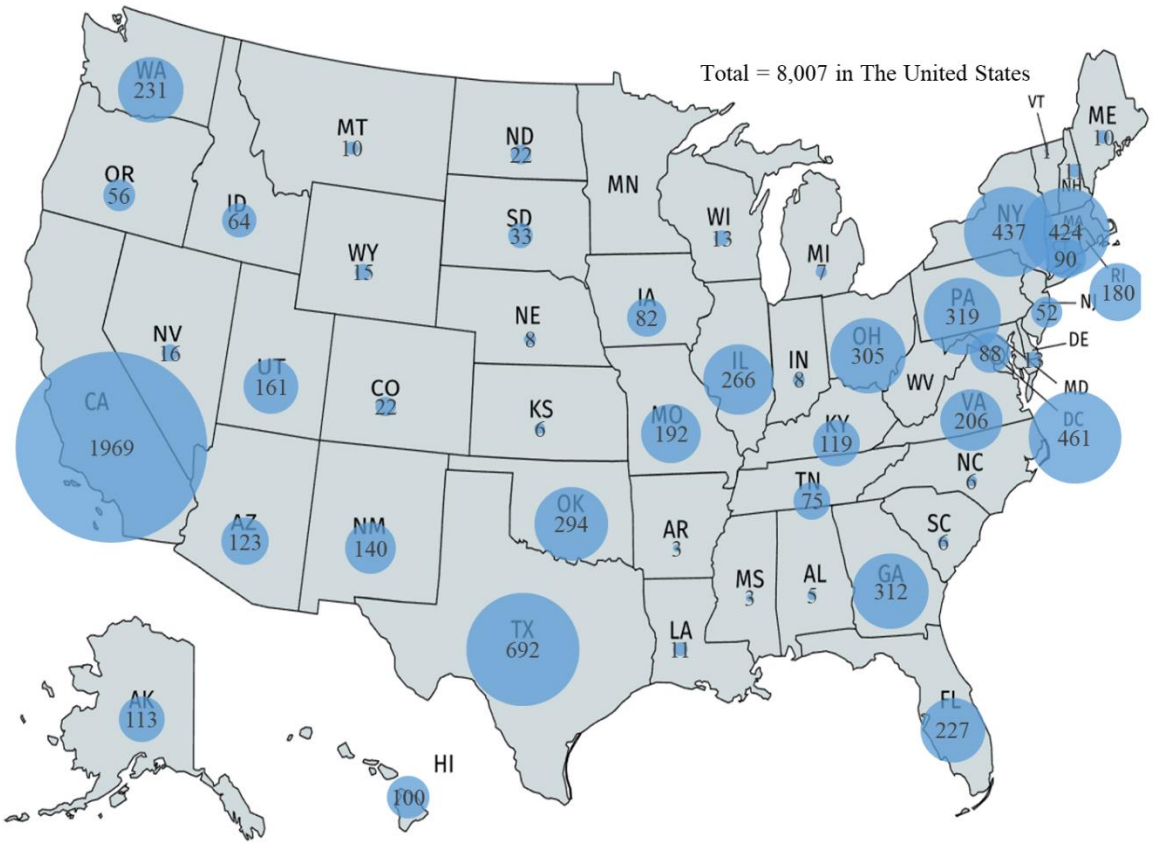

Figure 45. Numbers of Decertification between 2009 and 2019

The main reasons ranging from the most to least common for decertification are

(1) failure to cooperate with recipient requests for information or being nonresponsive,

(2) request to withdraw or remove from the DBE program,

(3) the firm is not owned and controlled by socially and economically disadvantaged individuals,

(4) the company has closed, or the owner has passed away,

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(5) the company has been sold, and its ownership has changed, and

(6) exceeding limits of personal net worth or three-year average revenue.

The database also includes 283 appeal decisions[15] over the same years of 2009 to 2019. Figure 46 shows the numbers of upheld, reversed, and remanded decisions. More than 50% of appeals were upheld. However, some reversed decisions indicate that some legitimate DBEs have probably been decertified or denied.

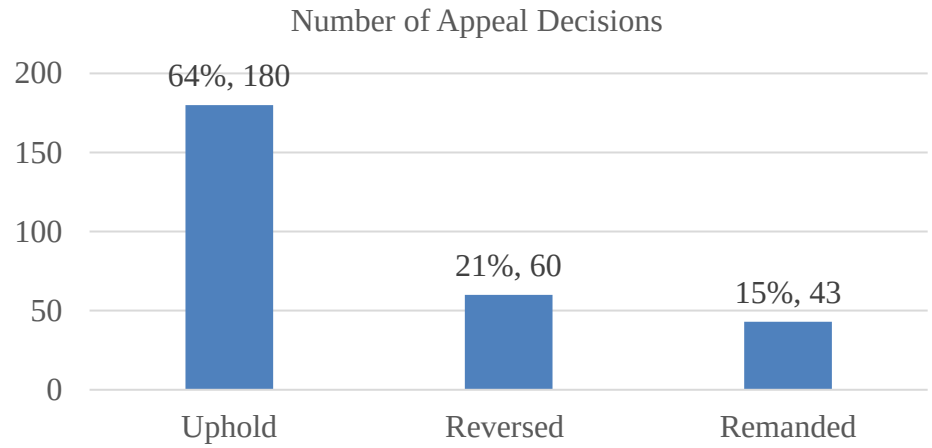

Figure 46. Numbers of DBE Certification Appeal Decisions between 2009 and 2019

The terms “decertification” and “denial” are not clearly defined except in terms of denial being for initial application and decertification being for the monitoring and reassessing of DBE eligibility. Although the certification procedures through the UCP are similar for different states, both the eligibility criteria and the findings of on-site visits are subject to the agency’s interpretation. As a result, a certified DBE in one state may experience denial in another state, resulting in their decertification in their home state. Due to limited staff and resources, some states conduct phone or video interviews for out-of-state certifications instead of on-site visits.

[15] The 49 CFR §26.89 describes the process for certification appeals.

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The US DOT DOCR database does not currently include qualitative indicators such as the level of severity for DBE regulation violations; dollar values identified as associated with a given instance of DBE fraud, waste, or abuse; the DBE's history of criminal prosecutions; administrative sanctions, suspension, or debarment imposed on the DBE; and periods of imprisonment served for DBE violations. This information could usefully be added to the US DOT DOCR database in collaboration with OIG investigations to provide a holistic and historical perspective. Furthermore, the US DOT DOCR should add database records for non-DBE contractors who frequently abet and conspire with DBEs on federally assisted contracts.

The OIG database has over 1,000 investigations related to DBE fraud from 1998 to 2019. The database has multiple filters such as date (e.g., 2017), type (e.g., investigation, audit report), agency (e.g., FHWA, FTA), and oversight area (e.g., criminal investigations, aviation). Each investigation has a date, title, and description with additional related items if any. A typical DBE fraud investigation takes approximately six months to four years to complete (NCHRP, 2007). Some sophisticated schemes that involve multiple investigations and extensive coordination among federal and state agencies are difficult and time-consuming and take more than four years (e.g., six years for Marikina Construction Corporation and Schuylkill Products, Inc.).

A database search for the keywords "DBE fraud" as of July 1, 2019, resulted in 1,018 investigations. These investigations were under many agencies, including the Federal Highway Administration (FHWA) with 293, the Federal Transit Administration (FTA) with 109, and the Federal Aviation Administration (FAA) with 233 investigations. Figure 47 illustrates the number of investigations by these three agencies for each year from 2001 to 2018. The solid line shows the total number of investigations each year. The polynomial trend line indicates the increase in DBE fraud investigations over time.

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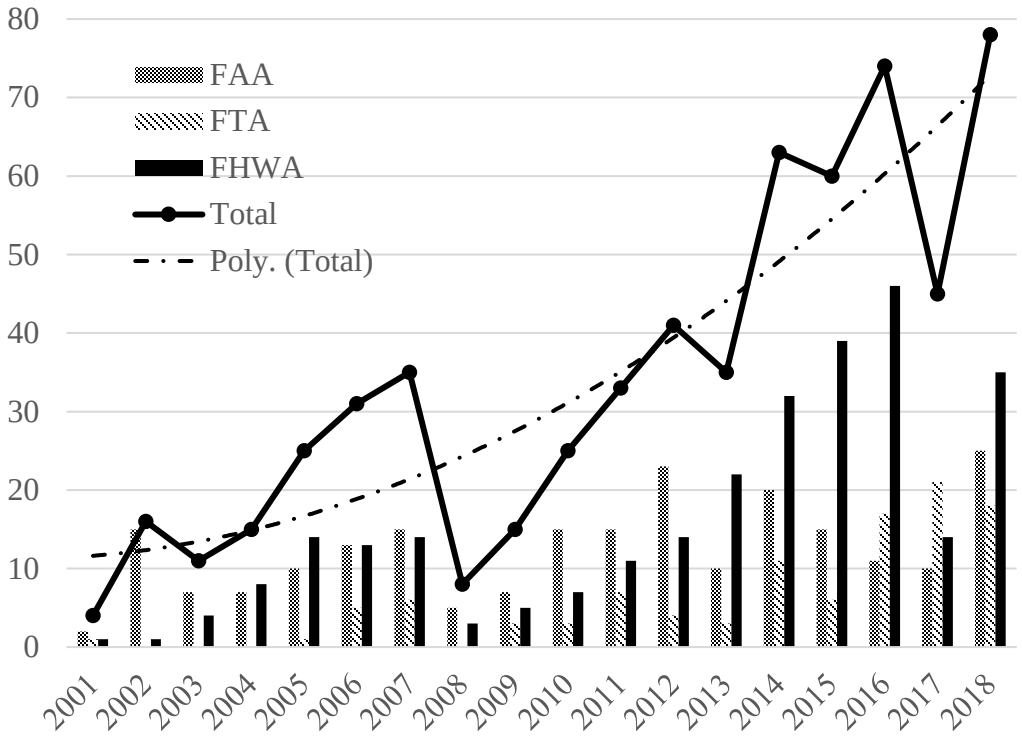

Figure 47. US DOT OIG DBE Fraud Investigations under FHWA, FTA, and FAA

The number of investigations dropped significantly in 2008, possibly because of the recession. The less marked decrease in 2013 may be linked to the OIG having released a report in the early part of that year that criticized the weaknesses of the DBE program and exposed the high risk of DBE fraud (Office of Inspector General 2013). The US DOT responded to the report by strengthening the DBE program to minimize such risk.

The author analyzed investigations by identifying if the words "disadvantaged business enterprise" or "DBE" appears in the title or description. Then, the research read all DBE investigations, group them by the DBE or non-DBE prime contractor, and code each group by a scheme of DBE fraud. Figure 48 shows the qualitative groups of DBE fraud investigation. Approximately half investigations identify DBE or disadvantaged business enterprises in the title or description under FHWA and FTA. Only approximately 15% of investigations identify DBE under the FAA. The number of groups is less than half of the identified investigations because

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some groups have up to ten investigations, and other groups have only one investigation in each group.

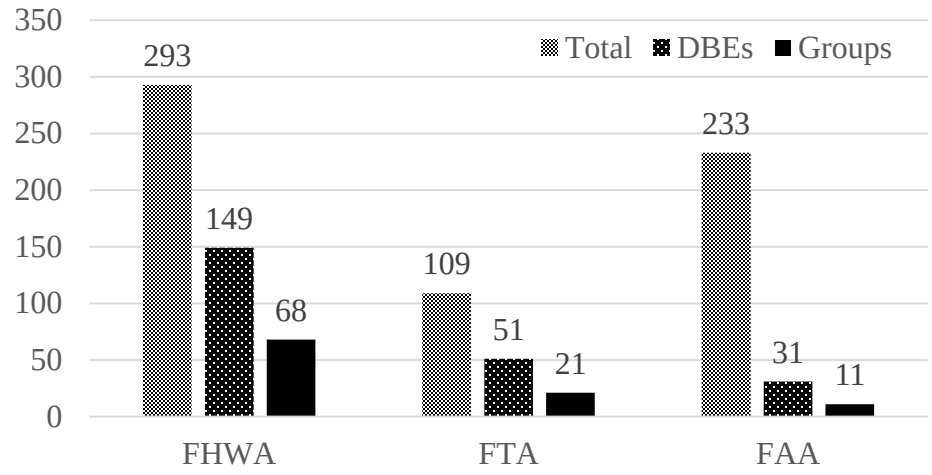

Figure 48. Qualitative Groups of DBE Fraud Investigations

Common DBE Fraud and Abuse Schemes

The common DBE fraud and abuse schemes are ineligible firms benefiting from the program, certified DBEs serving as a front for ineligible firms, certified DBEs conspiring a pass-through scheme, or prime contractors false claiming DBE goal on an awarded contract. After analyzing and coding 289 investigations (i.e., the sum of DBEs from FHWA, FTA, and FAA in Figure 6), the author identifies 100 groups. Table 18 summarizes the DBE fraud schemes. The descriptive data is followed by a description and example of each scheme in order of frequency. The US Department of Justice and DOT OIG defined and described front and pass-through schemes in various investigations and press releases. Fabrication and False Claims emerged from qualitative coding of OIG investigations along with related others.

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Table 18. Group Descriptions and Schemes of DBE Fraud Investigations

Companies Involved	Scheme	Total # of Investigations
WMCC, Inc. and Century Steel Erectors	Front	10
Karen Construction, Inc. and Weber Steel	Front	9
Marikina Construction Corporation and Schuylkill Products, Inc.	Front	9
Fairview Contracting Corporation and Perini Construction, Inc.	Front	8
MS Construction and Crossboro Construction Contracting	Front	6
V.V.S.S. Co., Inc. and BCM Industries, Inc.	Front	3
Landsite Contracting Company and Perini Construction, Inc.	Front	1
	Total Investigations of DBE Fronts: 46	
Styx Cuthbertson Trucking Company, Inc. and Boggs Paving, Inc.	Pass-through	9
Vertech International, Inc.	Pass-through	5
Global Marine Construction Supply	Pass-through	4
HD Supply Waterworks	Pass-through	4
Rexford Albany Municipal Supply Company, Inc. and ING Civil	Pass-through	4
Markias, Inc. and Alpha Painting and Construction, Inc. and Liberty Maintenance Inc.	Pass-through	3
Nuvo Construction and Sonag Company, Inc.	Pass-through	3
Patton Construction, Inc.	Pass-through	3
Sanzo Ltd.	Pass-through	3
Nationwide Fence and RMD Holdings	Pass-through	2
	Total Investigations of Pass-Through Schemes: 40	
MarCon Construction	Fabrication	5
Buveck Consultants, LLC	Fabrication	3
TesTech and CESO International, LLC; CESO, Inc.; CESO Testing Technology, Inc.	Fabrication	2
	Total Investigations of Fabrications: 10	
Tri-State Construction	False Claims	3
Civil Constructors, Inc.	False Claims	3
Premier Constructors	False Claims	3
	Total Investigations of False Claims: 9	
Various indictments by Manhattan District Attorney's Office, New York	Bribery	4
Southeast Underground and Utilities, Inc.	Bribery	2
	Total Investigations of Bribery: 6	
Mimosa Construction Inc.	Bankruptcy	4
	Total Investigations of Bankruptcy: 4	

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Front

The front (or shell) DBE fraud scheme has all work done by the non-DBE prime contractor or subcontractor while using the DBE as a front to claim credits or goal accomplishment to meet the DBE program or contract requirements. Often, the front DBE is entirely a setup, having falsified documents. Some DBE "owners" have another full-time job outside of the DBE business and have limited control over or make an only minimal contribution to the business. It is often the non-DBE that does all the contracted work, paying a small fee to the front DBE for its "service."

The front scheme in DBE fraud often involves a large number of contracts over a long period. For example, Century Steel Erectors used WMCC, Inc., as a front for finding, negotiating, coordinating, performing, managing, and supervising DBE subcontracts in bridge construction. Century Steel Erectors paid WMCC, Inc. a small "fixed-fee" for using their certified DBE status. One investigation in 2014 found that $42.6 million of WMCC, Inc. contracts had actually been performed by Century Steel Erectors, and another investigation in 2016 alleged Century Steel Erectors was behind more than $27 million in DBE fraud. In 2018, the US District Court ordered the owners of WMCC, Inc. and Century Steel Erectors to pay jointly $85,221.21 in restitution. Also, the Court sentenced the owner of WMCC, Inc. to two years of probation and a $1,000 fine and the owner of Century Steel Erectors to three years' probation, a $30,000 fine, and 300 hours of community service. The FHWA debarred both companies for three years.

Pass-through

The pass-through scheme in DBE fraud, like in the case of a DBE front, involves work done by the non-DBE prime contractor or subcontractor. The DBE is usually not ready, willing, or able to do all of the contracted work and performs no or limited commercially useful function

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related to the contract. In some pass-through schemes, certified DBEs allow some or all US-DOT-contract-related work to pass through to a non-DBE prime contractor or subcontractor, with the DBE serving as a broker or middleman either in the supply of materials or in construction. However, unlike a front, the company, and the owner can complete some of the work and is not a setup.

The pass-through scheme in DBE fraud is often sophisticated, especially in large contracts. For example, Vertech International, Inc., was found to have served as a pass-through DBE for a joint venture working on the federally funded George C. Platt Memorial Bridge Project. The overall contract value was approximately $42.7 million, with $3.1 million committed to Vertech International, Inc. as the DBE responsible for supplying paint materials. However, the joint venture, in fact, ordered its paint materials directly from a non-DBE supplier. Vertech International, Inc. performed no or minimum commercially useful function except processing supply invoices for a small fee[16]. The Pennsylvania DOT paid an unwarranted $1.97 million in DBE credit to the joint venture. In 2016, the US District Court sentenced the owner of Vertech International, Inc. to 12 months of probation and a $10,000 fine.

Fabrication

The fabrication scheme in DBE fraud involves deliberately forging documents to meet the eligibility criteria (e.g., personal net worth limitations) or to intentionally disguise deviations from the truth to benefit from the DBE program.

One common fabrication scheme is artificially lowering personal net worth to benefit from the DBE program. Another fabrication scheme involves forging documents to gain benefit from the DBE program. For example, Thomas Burse, the owner of Buveck Consultants, LLC,

[16] The joint venture paid Vertech 1.75 percent of the face value of the supply invoices to Vertech.

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forged college transcripts and a diploma claiming a bachelor of science degree in both civil engineering and business administration[17]. These false credentials allowed Burse to expand his DBE services and obtain engineering contracts from Wisconsin DOT. An audit also revealed Burse had overcharged by billing for the same work twice, inflating billable hours, and exaggerating hourly rate. The US District Court later concluded that overbilling by Burse had cost the Wisconsin DOT $1.3 million.

A sophisticate fabrication scheme is that the wife is the owner, but the Caucasian husband (i.e., White male) controls the business and does all the work. The wife has no previous education or experience in the contracted work and does not control or manage the daily business operation. An example is the Stealth Group, Inc. owned by the wife of Anthony Cappello. Cappello obtained more than $2.3 million DBE and Women Business Enterprise contracts from the Chicago Department of Aviation between 1999 and 2006. The US District Court sentenced Cappello 6 months of home confinement, 24 months of probation, a $25,000 fine, and a $169,676 restitution.

False claims

In DBE fraud, false claims often refer to a non-DBE prime contractor or subcontractor claiming to have used a DBE to meet contract requirements while, in fact, having used a non-DBE to perform some or all of the work asserted to have been performed by a DBE. False claims often come from prime contractors. Some DBEs' use of non-DBE employees and equipment can also result in false claims.

[17] Thomas Burse v. State of Wisconsin, No. 15-1649 (7th Cir. 2015). Burse claimed an engineering degree from Illinois State University in one resume but from Bradley University in another. He twice provided forged documents. Bradley University later reported that Burse attended for approximately one year and did not graduate or obtain a degree.

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For example, Tri-State Construction in Tacoma, Washington, submitted false claims to the federally funded I-5 High Occupancy Vehicle (HOV) lane project. The investigation indicated that Tri-State Construction owned and operated a stormwater treatment system related to the project but submitted invoices to the Washington DOT, claiming that a DBE was renting the system. This false claim misled the Washington DOT into counting the invoice for DBE credits on the project. Tri-State Construction ultimately agreed to pay $142,440 for false claims.

In 2015, Granite Construction (Granite) agreed to pay more than $8 million to settle false claims alleged to DBE participation on a federally funded bus depot in Queens, New York. According to the non-prosecution agreement, Granite used a front company and provided false reports to meet the DBE requirements on the project between 2004 and 2008. The Metropolitan Transportation Agency (MTA) awarded Granite Construction Northeast, Incorporated (GCN) approximately $222 million contracts, of which about $22 million should be awarded subcontracts to DBEs. GCN paid a DBE front company $500,000 for running through payrolls and false paperwork required by the DBE program.

Related others

DBE fraud and abuse cases can involve multiple sophisticated schemes. Besides DBE fronts, pass-through, false claims, and fabrication, these cases may involve conspiracy, mail fraud, wire fraud, extortion, kickbacks, money laundering, tax evasion, and bribery and corruption of public officials.

The Manhattan District Attorney's Office, New York, has indicted multiple public officials for bribery. A manager at the New York City Department of Environmental Protection was found guilty of leaking information about city contracts to HAKS Engineers, Architects, & Land Surveyors, DPC, as well as others, taking gifts, hotel stays, and employment opportunities

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for relatives in return. HAKS Engineers, Architects, & Land Surveyors, DPC acquired a DBE firm, falsifying ownership to obtain more than $10 million in public contracts.

Mimosa Construction, Inc., was a certified DBE that worked on a $7.7 million subcontract on the Alexander Hamilton Bridge Rehabilitation Project in New Jersey. The total value of the project was $416 million. During the project, the owner of Mimosa Construction, Inc., transferred assets and cashed out federal funds through various contractors and check-cashing facilities. Mimosa Construction, Inc. ultimately declared bankruptcy due to the inability to pay workers and creditors. The US District Court sentenced the owner of Mimosa Construction, Inc. in 2016 to 15 months of incarceration and three years of supervised release. The Court also ordered the trustee of Mimosa Construction, Inc.'s bankruptcy estate to pay $448,841.68.

The interview participants revealed that a public official awarded most contracts to a specific white woman-owned DBE. Participants believe some officials or contractors purposefully award contracts to a specific group such as white women. Some awarded a contract and later sabotaged the contract so that non-DBE contractors could get the project. An African American woman-owned business described the revenue of her business dropped from $3.5 million to less than $100,000, with the number of employees dropped from 25 to two.

Selective Case Studies

Marikina and Schuylkill Products, Inc.

The US Attorney's Office in Harrisburg, Pennsylvania, charged Timothy Hubler, former Vice President of Field Operation at CDS Engineers, Inc. (CDS) for a false tax return. The Office alleged Hubler with DBE fraud based on information provided by a source that alleged CDS, a subsidiary of Schuylkill Products, Inc. (SPI). The US DOT OIG detected SPI was using Marikina Construction Corporation (Marikina) as a DBE front on approximately 340 federal

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funded subcontracts with a total value of $121 million in 2008. For instance, CDS and SPI prepared cost estimates and bid proposals for Marikina to obtain DBE subcontracts. Work crews from CDS and SPI completed work and paid through Marikina's payroll to conceal the scheme. SPI and CDS paid a small fixed fee for using Marikina as a front. Investigations in 2009 and 2010 revealed that Marikina received a total of $136 million DBE contracts between 1993 and 2008. Over the 15 years, the group conspired numerous fraud, including mail, wire, tax evasion, and money laundering, resulting as the largest DBE fraud in the nation's history. In 2014, the US District Court sentenced owners of Marikina and SPI for two to seven years in prison and three to 12 years debarment.

Karen Construction and Weber Steel

Weber Steel, owned by Dennis Weber, is a non-DBE bridge and highway construction contractor in Kutztown, Pennsylvania. Weber Steel set up a DBE, Karen Construction, Inc. (Karen) owned by July Noll to obtain DBE subcontracts in Pennsylvania between 1995 and 2011. Conspiring with Weber Steel, Karen obtained 224 federally funded bridge projects with a total value of $18.7 million. Karen obtained an additional 133 federal funded bridge projects with a total value of 11.9 million. Investigations indicated that Weber Steel controlled Karen's business operation from multiple aspects, including purchasing, hiring, and project management and supervision. Both shared the same computer network, office space, equipment, materials, and employees. In 2016, the US District Court sentenced Weber Steel three years' probation and ordered to pay $1 million restitution to FHWA. The owners of Weber Steel were sentenced six months of home confinement and five years of probation. The owner of Karen, Judy Noll, was sentenced three years of probation and ordered to pay $336,000 restitution to FHWA.

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Styx Cuthbertson and Boggs Paving

Boggs Paving, Inc. (Boggs Paving) used Styx Cuthbertson Trucking Company, Inc. (Styx Cuthbertson) as a "pass-through entity" on 35 federally funded contracts with a total value of $87 million between 2003 and 2013. Boggs Paving should have contracted 3.7 million to Styx Cuthbertson, a certified DBE. Styx Cuthbertson only received about 10% of the value for actual work. The rest funneled back to Boggs Paving. In 2015, The US District Court sentenced Boggs Paving to pay a $500,000 fine. The Court sentenced the owners of Boggs Paving 15 to 30 months in prison and a fine ranging from $2,000 to $15,000. The Court also sentenced the owner of Styx Cuthbertson three months of home confinement, followed by 21 months of probation and a $2,000 fine.

Discussions and Recommendations

As made clear through the above analysis of US DOT DOCR and OIG database records, and the earlier literature review, DBE fraud is pervasive and has serious consequences in the construction industry. With limited efforts and resources, previous and ongoing investigations only identified a small portion of the problem, diminishing opportunities for legitimate DBEs and diverting federal funds from intended purposes. Commonly accepted practices for protecting the DBE program include denials for initial certification or decertification after identifying fraud. However, inconsistent practices across states and fragmented data make definitive conclusions difficult. To a degree, the numbers of denials and decertification are proportional to the number of certified DBEs in each state. However, these numbers also vary in relation to many other factors, such as the rigor of eligibility criteria, effort expended on contract compliance and investigation, and procedures for complaint and whistleblower protection. For instance, while California has many denials and decertification, the majority of these cases are because of

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nonresponsive actions such as failure to update a company's annual affidavit verifying no change or failure to cooperate with requests for information.

DBE fraud subverts the objectives and undermines the integrity of the program. Legitimate DBEs lose contracting opportunities. Federal funds are diverted from their intended purposes. Although US DOT must develop a well-coordinated, multi-disciplined, and inter-governmental approach to protect state transportation agencies against DBE fraud (US GAO 2001), these efforts, alone, likely will not reduce or eliminate DBE fraud. The author recommends raising DBE fraud awareness and enforcing fraud-prevention and detection in the DBE program as useful practices to combat DBE fraud. This could be accomplished, in part, by linking DBE denial and decertification data to OIG investigations. In addition, briefings, presentations, and conferences may be practical approaches to raising DBE fraud awareness. The author recommends that all DBE programs provide mandatory training in identifying DBE fraud for newly certified DBEs. Furthermore, such training and briefings should be made available to all entities currently involved in the DBE program, especially to the non-DBE prime contractors who subcontract work to DBEs. A DBE fraud investigation database has the potential to allow powerful analytics to support effective DBE fraud prevention practices. Consistent recording of systematically quantified DBE fraud according to identified scheme categorization is also vital for agile DBE fraud prevention and detection.

The contributions of this research are (1) descriptive statistics and qualitative narratives in relation to the national databases as regards DBE fraud, (2) identification of common DBE fraud schemes toward the goal of effective prevention and detection, and (3) recommendations for more effective data collection in relation to DBE fraud and abuse cases. This paper also has the potential to increase knowledge and understanding of DBE fraud among industry

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professionals and motivate academic researchers to explore possible strategies for minimizing DBE fraud as a major legal issue in construction.

Limitation and Delimitation

The scope of this analytic study has been limited to common DBE fraud schemes in the construction industry under FHWA, FTA, and FAA contracts. The study relates to but has not focused on other schemes such as bid-rigging, quality control testing, or debris removal that are also potentially related to DBEs. Moreover, the DBE program has faced a wide range of legal challenges in the past. Many of these challenges are not included in the scope of this research paper.

The author harnesses data from two national databases to delimit the study from anecdotal and experience-based interviews. Although an interview offers many nuances for a specific DBE fraud and abuse case, it has a relatively high risk of bias with limitations in time and geographic locations. The two databases provide historical, reliable, and fact-driven data, which are vital to draw definitive conclusions regarding DBE fraud and abuse cases. Only with such data will inferential analysis regarding DBE fraud be available to assist public officials in managing the DBE program and achieving its important objectives.

Data Availability Statement

No data, models, or codes were generated or used during the study. Data is from publically available database sources.

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CHAPTER 8. GENERAL CONCLUSIONS

The DBE regulations and programs have been under debate for almost 45 years. Controversially, there have been both efforts to improve and arguments to eliminate the program. The general conclusions of this dissertation align with many syntheses and reports published by the National Academies Press (NAP), the US Government Accountability Office (GAO), and the US DOT Office of Inspector General (OIG).

Conclusions

The research uncovered DBE characteristics, revealed DBE challenges, identified useful supportive services, and summarized common fraud schemes for the success of DBEs in the transportation sector. Besides being small, certified DBEs constantly struggled with diminished contracting opportunities and limited access to resources because of systemic oppression and sporadic discrimination. Although the program has some success in achieving its objectives, more oversight, enforcement, and improvement are needed.

Characteristics of DBEs and practices of DBE programs are concluded below.

1. A large number of DBEs certified in a state yet a small number of DBEs participated in federally assisted contracts;
2. About 90 % of sampled DBEs have revenue less than $5 million;
3. About a quarter of sampled DBEs are in construction contracting and another quarter of sampled DBEs are in engineering consulting;
4. Most DBE owners have a bachelor's degree or higher, and some DBE owners emerge from trades without a college degree;
5. DBEs can stay in the program for a long time but generally tend to lose the DBE status and revenue around 33 years in business or 25 years as a certified DBE; and

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6. DBEs in engineering perform slight more percentage of DBE work in the revenue with less overall revenue than DBEs in construction.
7. About half of the 50 states did not meet their DBE goal in the fiscal year of 2018. The DBE goal-setting was inconsistent and negatively impacted DBEs when suddenly dropped by half.
8. Supportive services were ineffective and had no system or framework to assess the needs and measure the outcomes.
9. Although the DBE program provides opportunities to some DBEs, the program offers no successful pathway for graduation or competing in the marketplaces outside of the program.

DBE challenges are concluded below.

1. DBEs face challenges in contracting opportunities and business relationships because of bias and discrimination from prime contractors.
2. Lack of knowledge in navigating the project-letting process and using electronic bidding systems also creates barriers for DBEs to get contracting opportunities.
3. In general, DBEs struggle with doing business because of being small with diminished opportunities and limited resources (i.e., capital, workforce).
4. Overall, DBEs benefit from the DBE program and supportive services, but barriers still exist for participating in federally assisted contracts.
5. Although the DBE program and supportive services remove some barriers, the main barrier is that primes are not eager to work with DBEs and reluctant to use new DBEs given that DBEs have the capabilities to perform the contracted work.

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DBEs needed different supportive services at various sizes and in different areas. The author proposed a framework to provide business, engineering, construction, and other related supportive services to DBEs. Useful supportive services are listed below.

5. All business areas unanimously agree that tuition reimbursement is very or extremely useful.
6. Useful supportive services for DBE in construction contracting are the collaboration with other organizations, DBE program support, bidding, contract administration, quality assurance and control, and safety.
7. Useful supportive services for DBE in engineering consulting are the collaboration with other organizations, accounting, safety, contract administration, and job site management.
8. Useful supportive services for other DBEs are accounting, software and technology, bonding, project scheduling and cost control, and DBE program support.

DBE fraud is pervasive in the construction industry. Although inconsistent practices and fragmented data make definitive conclusions difficult, five common fraud schemes have emerged from qualitative and quantitative analysis. These five schemes are front, pass-through, fabrication, false claims, and related others. Additionally, two national databases supported the following conclusions:

1. The majority of decertification is because of non-responsive in annual affidavit no change or failure to cooperate with recipient requests for information.
2. Denial and decertification data do not link to OIG investigations, which makes data analyses and qualitative inferences difficult.

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The purpose of this study is to critically examine the DBE program, identify DBE challenges, propose useful supportive services, and reveal common DBE fraud schemes. The outcomes of the research help general audiences understand DBEs and DBE programs, inform policymakers on future regulatory changes, and improve the experience of DBEs and the quality of DBE programs.

Limitations

The major limitation of the research is the nature of the cross-sectional study, which collects and analyzes data from a sample population at a specific moment or period. The author collected most data from June to July 2019. The period seemed to be a busy time for DBEs in construction and limited both survey responses and interview participation. Data collection during winter may improve the response rate of the research inquiry.

This research study is limited to the DBE program at the state DOT level under FHWA, which is under US DOT. Particularly, the DBELO interview data collection is limited to 10 states. This study is limited to DBE in the construction industry and in contracting work with the DOT in the transportation sector. The data collection was limited by voluntary participation and honest feedback from DBEs. Additionally, this study does not address other DBEs, such as suppliers and truck drivers.

Limitations for qualitative results are numbers of interviews, cycles of coding, selection of coding techniques, and numbers of researchers. For example, the coding of the qualitative data was solely done by the author, which was limited by the author's understanding, knowledge, and positionality. Limitations for quantitative results are the numbers of variables in the DBE research and the low response rate of the survey. Unfortunately, the response rate may remain the same if the author only samples a portion of the DBEs nationwide and collects fewer

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numbers of responses from DBEs. Additionally, incomplete or unrealistic responses are omitted in the data analyses, which reduce the useful data size for quantitative analyses.

A surprising incident, occurred during the data collection phase, was that a DBE researcher received the DBE survey, copied the entirety of the survey, and sent the survey to DBEs in three states. Although the author took proper actions, DBEs had received the same survey twice. Some deemed it as scams. Some believed and filled the survey again. These ethical, cultural, and contextual settings were all limitations of the DBE research, sometimes creating a muddy field and making data collection difficult in research.

Future Research

Future research should focus on enforcing the DBE program, ensuring nondiscrimination, and promoting diversity and inclusion in federal contracts. Lack of census data creates significant barriers for drawing any meaningful research conclusions. One future research effort should be collecting quantitative data and establishing a national database for DBEs. Also, quantitative data enable rigorously and advance statistical analyses that inform accurate DBE goal-setting and effective resource allocation. With enough quantitative data, DBE research can benefit from big data, business analytics, machine learning, deep learning, and artificial intelligence.

The DBE program mainly assists with the status of being both socially and economically disadvantaged. DBEs may not be economically disadvantaged when reaching the limit of the personal net worth or the three-year average revenue. However, socially disadvantaged status seems to remain all the time. Although economic status improves social status, there is no evidence that social disadvantages or discrimination will disappear. Future research should look into whether DBEs should remain certified all the time without graduation or have other programs allowing DBEs to cope with social disadvantaged in a continuum. The DBE program

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allows both race-neutral and conscious approach, but have not dealt with conscious and unconscious discrimination in federal contracting. Previous research only focused on conscious discrimination with limited statistical and anecdotal evidence. Unconscious bias and systemic oppression are two major concerns for DBEs participation in all types of contracting work. Additionally, research should expand to DBEs that are underutilized. The proper identification of why they are underutilized will help DBE liaison officer manage the DBE program and assist DBEs with contract participation and business development.

This dissertation is the first research work collecting data from DBEs nationwide. Some recommended future research topics include, but are not limited to, the following:

1. Develop business integrated development models to assist DBEs to grow in the DBE program, compete in the marketplace outside of the DBE program, and mature to a relatively large and economic viable business.
2. Identify leadership competencies from successful DBE owners.
3. Improve DBE programs using game theory: align competitive and cooperative theories with race-conscious and race-neutral programs.
4. Propose alternative and innovative ways for DBE participation in federally assisted contracts.
5. Refine goal-setting methodology and reinforce goal achievement.
6. Transform contemporary disparity studies to real-time and cloud-based DBE participation systems.
7. Establish a mechanism for diversity and inclusion for all enterprises.

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Northern Contracting, Inc. v. Illinois Department of Transportation, 473 F.3d 715 (7th Cir. 2007) (Northern Contracting III).

Sherbrooke Turf, Inc. v. Minnesota Department of Transportation, 345 F.3d. 964 (8th Cir. 2003), cert. denied, 541 U.S. 1041 (2004).

West Tennessee Chapter of Associated Builders and Contractors, Inc. v. City of Memphis, 302 F.Supp.2d 860 (W.D. Tenn. 2004).

Virdi v. DeKalb County School District, 2005 U.S. App. LEXIS 11203 (11th Cir. June 13, 2005).

Western States Paving Co., Inc. v. Washington Department of Transportation, 407 F.3d 983 (9th Cir. 2005), cert. denied, 546 U.S. 1170 (2006).

Hershell Gill Consulting Engineers, Inc. v. Miami-Dade County, Florida, 333 F.Supp.2d 1305 (S.D. Fla. 2004).

Thompson Building Wrecking Co., Inc. v. City of Augusta, Georgia, 2007 U.S. Dist. LEXIS 27127 (S.D. Geo. March 14, 2007).

H. B. Rowe, Inc. v. Tippett, 2008 U.S. Dist. LEXIS 100569 (E.D. N.C. 2008).

Thomas Burse v. the State of Wisconsin, No. 15-1649 (7th Cir. 2015).

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List of Selectively Consulted Books for Research Methods

General Research

Cohen, L., Manion, L., & Morrison, K. (2013). Research methods in education. New York: Routledge.

Creswell, J. W. (2013). Research design: Qualitative, quantitative, and mixed methods approaches. Thousand Oaks, CA: Sage Publishing.

Gay, L. R., Mills, G. E., & Airasian, P. W. (2011). Educational research: Competencies for analysis and applications. Upper Saddle River, NJ: Pearson.

Miller, D. C., & Salkind, N. J. (2002). Handbook of research design and social measurement (6th edition). Thousand Oaks, CA: Sage Publishing.

Quantitative Research

Agresti, A., & Finlay, B. (2009). Statistical methods for the social sciences (4th Ed.). Upper Saddle River, NJ: Pearson.

Morgan, G. A., Leech, N. L., Gloeckner, G. W., & Barrett, K. C. (2012). IBM SPSS for introductory statistics: Use and interpretation (5th edition). New York: Routledge

Rovai, A. P., Baker, J. D., & Ponton, M. K. (2013). Social science research design and statistics: A practitioner's guide to research methods and SPSS. Chesapeake, VA: Watertree Press

Spector, P.E. (1981). Research design: Quantitative Applications in social science. Newburry Park, CA: Sage Publishing

Groves, R. M., Fowler Jr, F. J., Couper, M. P., Leplowski, J. M., Singer, E., & Tourangeau, R. (2004). Survey methodology. New York, NY: John Wiley & Sons.

Qualitative Research

Biklen, S. K., & Casella, R. (2007). A practical guide to the qualitative dissertation. New York: Teachers College Press.

Creswell, J. W. (2013). Qualitative inquiry and research design: Choosing among five approaches Thousand Oaks, CA: Sage Publishing

Maxwell, J. A. (2013). Qualitative research design: An interactive approach: An interactive approach. Thousand Oaks, CA: Sage Publishing.

Richards, L. (2015). Handling qualitative data: A practical guide. Thousand Oaks, CA: Sage Publishing.

Saldaña, J. (2015). The coding manual for qualitative researchers. Thousand Oaks, CA: Sage Publishing

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Cannella, G. S., Pérez, M. S., & Pasque, P. A. (Eds.). (2016). Critical qualitative inquiry: Foundations and futures. Routledge.

Hays, D.G., & Singh, A.A. (2012). Qualitative inquiry in clinical and educational settings. New York, NY: The Guilford Press.

Jones, S. R., Torres, V., & Arminio, J. (2013). Negotiating the complexities of qualitative research in higher education: Fundamental elements and issues. Routledge.

Mixed Methods Research

Creswell, J. W., & Clark, V. L. P. (2010). Designing and conducting mixed methods research (2nd Ed.). Thousand Oaks, CA: Sage Publishing.

Tashakkori, A., & Teddlie, C. (Eds.). (2010). Sage handbook of mixed methods in social & behavioral research. Thousand Oaks: Sage Publishing.

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List of DBE Related Syntheses and Reports

Airport Cooperative Research Program (ACRP)

a. 2013 ACRP Report 56

National Academies of Sciences, Engineering, and Medicine. 2013. Impact of Regulatory Compliance Costs on Small Airports. Washington, DC: The National Academies Press. https://doi.org/10.17226/22581.

b. 2015 ACRP Report 125

National Academies of Sciences, Engineering, and Medicine. 2015. A Guidebook for Increasing Diverse and Small Business Participation in Airport Business Opportunities. Washington, DC: The National Academies Press. https://doi.org/10.17226/22220.

c. 2016 ACRP Report 156

National Academies of Sciences, Engineering, and Medicine. 2016. Guidebook for Managing Compliance with Federal Regulations: An Integrated Approach. Washington, DC: The National Academies Press. https://doi.org/10.17226/23518.

Department of Housing and Urban Development (DHUD)

a. 1979 "A Survey of Minority Construction Contractors." Office of the Assistant Secretary for Equal Opportunity, US Department of Housing and Urban Development, Washington, D.C.

Government Accountability Office (GAO)

a. 1979 GAO CED-79-9

Report to the Congress: Minority Firms on Local Public work Projects-Mixed Results

b. 1985 GAO/RCED-85-31

Information on the Federal Highway Administration's Disadvantaged Business Program

c. 1988 GAO/RCED-89-26

Highway Contracting: Assessing Fraud and Abuse in FHWA's DBE Program

d. 1989 GAO/RCED-89-78

Highway Contracts: Federal-Aid Highway Contracts Awarded to Minority- and Women-Owned Businesses

e. 1994 GAO/RCED-94-168

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Highway Contracting: Disadvantaged Business Program Meets Contract Goal, but Refinements Are Needed

f. 2001 GAO-01-586

Disadvantaged Business Enterprises: Critical Information is Needed to Understand Program Impact

g. 2011 GAO-12-78

Disadvantaged Business Enterprise Program: Assessing Use of Proxy Data Would Enhance Ability to Know if States are Meeting Their Goals

Minority Business Development Agency

a. 1999 The New Realities for Minority Business

b. 1999 Minority Population Growth: 1995 to 2050

c. 1999 Dynamic Diversity: Projected Changes in US Race & Ethnic Composition 1995 to 2050

d. 2000 The Emerging Minority Marketplace, US Department of Commerce

e. 2001 Minority business development: economic value and benefits

f. 2006 The state of minority business enterprises: An overview of the 2002 survey of business owners

g. 2008 Characteristics of Minority Businesses and Entrepreneurs

h. 2014 US Minority-Owned Manufacturers

i. 2015 The State of Minority Business Enterprises: An Overview of the 2007 Survey of Business Owners

j. 2015 Minority Exporters: Characteristics and Strategies for New Business and Expansion

k. 2018 Latino Business Ownership: Contributions and Barriers for US-Born and Immigrant Latino Entrepreneurs

National Cooperative Highway Research Program (NCHRP)

a. 2005 NCHRP Synthesis 343

National Academies of Sciences, Engineering, and Medicine. 2005. Management of Disadvantaged Business Enterprise Issues in Construction Contracting. Washington, DC: The National Academies Press. https://doi.org/10.17226/13817.

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b. 2007 NCHRP Web-Only Document 120

National Academies of Sciences, Engineering, and Medicine. 2007. A Survey of State Practices for Protecting Transportation Agencies Against Construction and Disadvantaged Business Enterprise Fraud Including Use of Contractor Suspension and Debarment Procedures. Washington, DC: The National Academies Press. https://doi.org/10.17226/23133.

c. 2007 NCHRP Report 585 (Transit Cooperative Research Program [TCRP] Report 120)

National Academies of Sciences, Engineering, and Medicine. 2007. Racial and Gender Diversity in State DOTs and Transit Agencies. Washington, DC: The National Academies Press. https://doi.org/10.17226/22010.

d. 2010 NCHRP Report 644:

National Academies of Sciences, Engineering, and Medicine. 2010. Guidelines for Conducting a Disparity and Availability Study for the Federal DBE Program. Washington, DC: The National Academies Press. https://doi.org/10.17226/14346.

e. 2011 NCHRP Synthesis 416:

National Academies of Sciences, Engineering, and Medicine. 2011. Implementing Race-Neutral Measures in State Disadvantaged Business Enterprise Programs. Washington, DC: The National Academies Press. https://doi.org/10.17226/14505.

f. 2012 NCHRP Report 710

National Academies of Sciences, Engineering, and Medicine. 2012. Practical Approaches for Involving Traditionally Underserved Populations in Transportation Decisionmaking. Washington, DC: The National Academies Press. https://doi.org/10.17226/22813.

g. 2013 NCHRP Synthesis 448

National Academies of Sciences, Engineering, and Medicine. 2013. State Department of Transportation Small Business Programs. Washington, DC: The National Academies Press. https://doi.org/10.17226/22526.

h. 2015 NCHRP Synthesis 481

National Academies of Sciences, Engineering, and Medicine. 2015. Current Practices to Set and Monitor DBE Goals on Design-Build Projects and Other Alternative Project Delivery Methods. Washington, DC: The National Academies Press. https://doi.org/10.17226/22112.

i. 2019 NCHRP Report 913

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National Academies of Sciences, Engineering, and Medicine. 2019. Compendium of Successful Practices, Strategies, and Resources in the US DOT Disadvantaged Business Enterprise Program. Washington, DC: The National Academies Press. https://doi.org/10.17226/25538.

National Research Council (NRC)

a. 2005 NRC

National Research Council. 2005. Analyzing Information on Women-Owned Small Businesses in Federal Contracting. Washington, DC: The National Academies Press. https://doi.org/10.17226/11245.

Office of Inspector General (OIG)

a. 2013 OIG Audit Report: ZA-2013-072

Weaknesses in the department's disadvantaged business enterprise program limit the achievement of its objectives.

b. 2014 OIG Audit Report: ZA-2014-055

New DBE firms face barriers to obtaining work at the nation's largest airports

c. 2015 OIG Audit Report: ZA-2016-002

New DBE firms face additional barriers to obtaining work at the nation's largest airports

d. 2017 OIG Audit Report: ZA2017021

New DBE participation is decreasing at the nation's largest airports, and certification barriers exist

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APPENDIX A. IRB APPROVAL AND EXEMPT LETTER

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
2420 Lincoln Way, Suite 202
Ames, Iowa 50014
515 294-4566

Date: 02/01/2019

To: Jennifer Shane

From: Office for Responsible Research

Title: Interdisciplinary Studies for the Success of the Disadvantaged Business Enterprise Providing Construction and Professional Services in the Transportation Sector - Phase I

IRB ID: 19-056

Submission Type: Initial Submission **Exemption Date:** 02/01/2019

The project referenced above has been declared exempt from most requirements of the human subject protections regulations as described in 45 CFR 46.104 or 21 CFR 56.104 because it meets the following federal requirements for exemption:

2018 - 2 (ii): Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) when any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation.

The determination of exemption means that:

- **You do not need to submit an application for continuing review. Instead, you will receive a request for a brief status update every three years. The status update is intended to verify that the study is still ongoing.**
- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any *modifications to the research procedures* (e.g., method of data collection, nature or scope of information to be collected, nature or duration of behavioral interventions, use of deception, etc.), any change in *privacy or confidentiality protections*, modifications that result in the *inclusion of participants from vulnerable populations*, removing plans for informing participants about the study, any *change that may increase the risk or discomfort to participants, and/or* any change such that the revised procedures do not fall into one or more of the regulatory exemption categories. The purpose of review is to determine if the project still meets the federal criteria for exemption.
- All *changes to key personnel* must receive prior approval.
- **Promptly inform the IRB of any addition of or change in federal funding for this study.** Approval of the protocol referenced above applies only to funding sources that are specifically identified in the corresponding IRB application.

IRB 01/2019

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Detailed information about requirements for submitting modifications for exempt research can be found on our website. For modifications that require prior approval, an amendment to the most recent IRB application must be submitted in IRBManager. A determination of exemption or approval from the IRB must be granted before implementing the proposed changes.

Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

Additionally:

- All research involving human participants must be submitted for IRB review. **Only the IRB or its designees may make the determination of exemption**, even if you conduct a study in the future that is exactly like this study.
- **Please inform the IRB if the Principal Investigator and/or Supervising Investigator end their role or involvement with the project** with sufficient time to allow an alternate PI/Supervising Investigator to assume oversight responsibility. Projects must have an eligible PI to remain open.
- **Immediately inform the IRB of** (1) **all serious and/or unexpected** adverse experiences involving risks to subjects or others; and (2) **any other** unanticipated problems **involving risks to subjects or others.**
- **Approval from other entities may also be needed.** For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted.**
- Your research study may be subject to post-approval monitoring **by Iowa State University's Office for Responsible Research.** In some cases, it may also be subject to formal audit or inspection by federal agencies and study sponsors.
- Upon completion of the project, transfer of IRB oversight to another IRB, or departure of the PI and/or Supervising Investigator, please initiate a Project Closure in IRBManager to officially close the project. For information on instances when a study may be closed, please refer to the IRB Study Closure Policy.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

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APPENDIX B. INFORMED CONSENT FORM

Welcome to the Research Studies about Disadvantaged Business Enterprise

Title of the Study
Interdisciplinary studies for the success of disadvantaged business enterprises providing engineering and construction services in the transportation sector

Principle Investigator
Jennifer Shane, Ph.D.
Department of Civil, Construction, and Environmental Engineering
Iowa State University
Phone: (515) 294-1703
Email: jsshane@iastate.edu

Graduate Research Assistant
Hongtao Dang, P.E. (IA)
Department of Civil, Construction, and Environmental Engineering
Iowa State University
Phone: (515) 294-6346
Email: hitdang@iastate.edu

Part I: Research Information

1.0 Introduction

My name is Hongtao, and I am a doctoral candidate in the Department of Civil, Construction, and Environmental Engineering Department at Iowa State University. I am conducting interdisciplinary studies for the success of Disadvantaged Business Enterprises (DBEs) providing engineering and construction services in the transportation sector. My doctoral research consists of four parts.

Part 1: Describe Characteristics and Practices of DBEs and DBE Programs
Part 2: Construct Business Integrated Development (BID) Models for DBEs
Part 3: Propose a Framework for Providing Effective Supportive Services
Part 4: Uncover Leadership from Successful Owners of DBEs

I am inviting you to participate in one of the parts and provide you more information in this informed consent form (ICF). Please read this ICF and email me at hitdang@iastate.edu if you have any question. If this ICF contains any word or terminology that you do not understand, please ask me, and I will be happy to explain.

1.1 Purpose of the Research

The purpose of the research is to investigate the success of DBEs providing engineering and construction services in the transportation sector. The U.S. Department of Transportation requires a DBE program in each state Department of Transportation (DOT) to ensure nondiscrimination and create a level playing field for all enterprises (CFR 49 Part 26), especially assist DBEs to develop and compete fairly, in federal-assisted contracts. Each DOT manages and operates the DBE program differently depending on DBE characteristics (e.g., number of certified DBEs, ethnicity variation, and business types) and available resources (e.g., funding and supportive services). The research team is interested in learning about your experience with

Participant's Initials: _____

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DBEs as liaison officers in the DBE programs, contractors who are non-DBE but work extensively with DBEs, or owners of DBEs.

1.2 Type of Research Intervention
The data collection methods are either semi-structured interviews or survey questionnaires. You may participate through either one or both ways. Interviews help the researcher gather qualitative data such as descriptions, discussions, stories, and beliefs. Surveys help the researcher collect quantitative data such as numbers and ratings.

1.3 Procedures and Duration
Both interviews and surveys follow rigorous reviews and pilots using the anti-oppression framework and cognitive interviews. Semi-structured interview protocol has a list of questions. Surveys have various questions in multiple branches with advanced logic and flow. The researcher will send the interview protocol to a participant before the semi-structured interview. The researcher will send a survey link to a respondent with a detailed explanation of the research study.

The interview should take approximately 60 minutes to complete. We want to schedule one and a half hours to allow flexible introduction in the beginning and additional comments at the end. Ideally, the researcher interviews one participant via phone. Multiple participants can join the interview if they contribute to different aspects of the interview questions. The researcher will treat multiple participants' responses as one anonymous participant's responses in the data analyses, results, and conclusions.

The survey should take approximately 20 minutes to complete. The researcher will send a survey to participants via email. The researcher will send several friendly reminders to participants who have not completed the survey. The survey respondents are encouraged to consult with colleagues or search previous documents to answer the survey questions as accurate as possible. The survey respondents may print all questions and collect information before entering data and completing the survey.

1.4 Participant Selection
We want to invite you to take part in this research because we feel that your experience contribute much to our understanding and knowledge about the success of DBEs in the engineering and construction industry. Our selected population includes three types of interview participants and survey respondents. The first type is the Disadvantaged Business Enterprise Liaison Officer (DBELO) or equivalent. The second type is the normal business enterprise (NBE), who is not a disadvantaged business enterprise. The NBE represents the norm and non-DBEs. The preferred NBE should work extensively with DBEs for at least three years. The third type is the disadvantaged business enterprise (DBE). All DBEs are welcome to participate. Some parts of the study prefer interviews from DBEs who work on many federal-assisted projects and have been successfully growing their businesses. Some survey questions filter and direct DBEs to different branches depending on their businesses.

Participant's Initials: _____

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1.5 Voluntary Participation
Your participation is voluntary. You have the right to withdraw at any time during the study, for any reason, and without any prejudice. Retreating from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, the researcher will exclude your responses from the study and permanently delete your data.

1.6 Risks and Benefits
There are no foreseeable risk or harm to participants in this study. You may decline to answer any or all questions. You may terminate your participation at any time. There are minimal or no psychological discomforts (e.g., upset or nervousness), social discomforts (e.g., embarrassment), or informational concern (e.g., personal information) in the discussion/interview/survey. There is an incidental risk that you may share some personal or confidential information by chance, or that you may feel uncomfortable talking about some of the topics. However, we do not wish for or anticipate this to happen. We will remove identifiable information by default and any other recorded information upon request. You do not have to answer any question or take part in the discussion/interview/survey if you feel the question(s) are too personal or if talking about them makes you uncomfortable.

There will be no direct benefit to you, but your participation is likely to help us understand more about DBEs and DBE programs. The understanding and knowledge inform policymakers on future regulatory changes and improve the experience of DBEs and the quality of DBE programs, which can potentially boost the economy, improve efficiency, and reduce cost on federally funded projects.

1.7 Confidentiality
Your responses are confidential and anonymous. We will not record your name or any identifiable information. We will remove all identifiable information (e.g., name, email, phone numbers), if any by accident, from our data. We will keep all interview/survey data in an encrypted computer. The researcher will not share data with anyone outside of the research team. The research team will make every effort to preserve your confidentiality, including but not limited to, the following:

1. Assigning pseudo names or code numbers for participants that will be used on research notes and interview transcriptions.
2. Keeping research notes, interview recordings and transcriptions, and any other documents (if any) in a locked file cabinet in the personal possession of the researcher.

1.8 Sharing the Results
Nothing that you tell us will be shared with anybody outside the research team, and nothing will be attributed to you by name or any other identifiable information. The knowledge that we get from this research will be shared with you before it is made widely available to the public. Your responses will NOT attribute to you, your state, or your business. The researcher will only release information and results in summary forms. The final manuscript is available to participants upon request.

Participant's Initials: _____

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1.9 Rights to Refuse and Withdraw
You have the rights to refuse and withdraw from this study at any time and without giving a reason. You do not have to take part in this research if you do not wish to do so, and not choosing to participate will not affect your job or job-related evaluations in any way. You may stop participating in the discussion/interview/survey at any time that you wish without affecting your current job or future career.

1.10 Contact Information
The Institutional Review Board (IRB) from the Office for Responsible Research at Iowa State University has reviewed and approved this research in February 2019. The IRB is a committee whose task is to make sure that the researcher protects research participants from harm. If you have any questions at any time about this study, you may contact the researcher via the contact information provided below.

Mr. Hongtao Dang, P.E. (IA)
Phone: (515) 294-6346
Email: hitdang@iastate.edu

Dr. Jennifer Shane, Ph.D.
Phone: (515) 294-1703
Email: jsshane@iastate.edu

If you have questions regarding your rights as a research participant, or if problems arise which you do not feel you can discuss with the Primary Investigator, please contact the Institutional Review Board at (865) 354-3000, ext. 4822.

Part II: Certification of the Informed Consent

2.0 Consent
By signing below, you acknowledge that your participation in the study is voluntary, you are at least 18 years of age, and that you are aware that you may choose to terminate your participation in the study at any time and for any reason.

I have read the above information, or someone has read to me. I have had the opportunity to ask questions about it. The research team has answered all my questions, if any, to my satisfaction. I consent voluntarily to be a participant in this study.

Print Name of Participant_____
Signature of Participant _____
Date (MM/DD/YYYY) _____

Print Name of Researcher_____
Signature of Researcher _____
Date (MM/DD/YYYY) _____

Participant's Initials: _____

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APPENDIX C. DBE SURVEY DESIGN

Introduction.

Welcome to the Research Study about Disadvantaged Business Enterprises

I am a researcher working with a professor at Iowa State University and Institute for Transportation on a study related to Disadvantaged Business Enterprises (DBEs). We are inviting you because we identified you as a DBE in your state. Your participation in this study should take less than 20 minutes. Your honest feedback will help us better understand DBEs and DBE programs, inform policymakers on future regulatory changes, and improve the experience of DBEs and the quality of DBE programs. We need your help to complete this critical study.

The Institutional Review Board (IRB) at Iowa State reviewed and approved this study in February 2019. All responses will remain anonymous and be confidential to the IRB approved researchers. Your participation is voluntary, and we greatly appreciate your assistance and support. If you want to contact the researcher for questions, please e-mail Mr. Hongtao Dang at hitdang@iastate.edu.

More information about the study is available in the Informed Consent Form (ICF) through the link below. Please read the ICF and choose "I agree to participate after reading the ICF" to begin the survey.
Link: Informed Consent Form for the Research Study about Disadvantaged Business Enterprises

- (●) I agree to participate after reading the ICF.
- ( ) I decline to participate after reading the ICF.

Q1. Please indicate in which state you received your initial DBE certification.

My firm got the first DBE certification in [▼]

Q2. Which group is your firm certified under in the DBE program?

- ( ) Caucasian (White) Women
- ( ) Black Americans
- ( ) Hispanic Americans
- ( ) Native Americans
- ( ) Asian-Pacific Americans
- ( ) Subcontinent Asian Americans
- ( ) Other, designated by Small Business Administration

Q3. Please indicate your gender.

- ( ) Male
- ( ) Female

Q4. Please indicate your highest level of education.

- ( ) Attended high school but did not finish
- ( ) High school diploma
- ( ) Attended college but did not finish
- ( ) Vocational or technical degree

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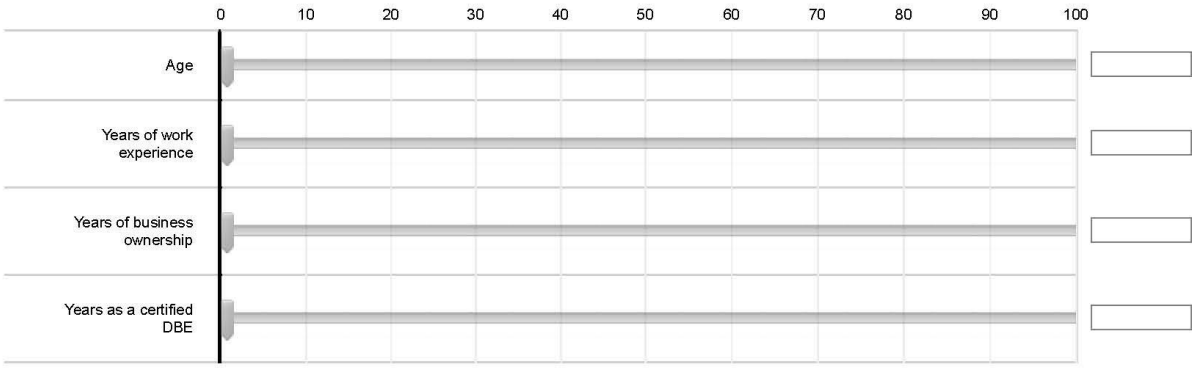
- ○ Associate degree
- ○ Bachelor's degree
- ○ Master's degree
- ○ Doctorate degree
- ○ Other

Q5. Please select ALL professional licenses or certifications you have attained.

- ☐ Certified Professional Constructor (CPC)
- ☐ Project Management Professional (PMP)
- ☐ Professional Engineer (PE)
- ☐ Professional Surveyor (PS)
- ☐ Certified Erosion Control Technician
- ☐ Other
- ☐ None of the above

Q6. Please use the slide bar to indicate your age as well as experience in general areas of your certified DBE NAICS codes.



Q7. For a typical week, how many hours do you spend on each of the following area as the owner of your DBE?

Company management (e.g., admin, plan, supervise)	0
Engineering (e.g., analyze, design, review)	0
Construction (e.g., estimate, bid, perform)	0
Communication (e.g., meetings, conferences, networking, marketing)	0
Others	0
Total	0

Q8. Please indicate your income from your DBE in the last year.

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Note:
- Please exclude any other incomes that are not from your DBE.

- Less than $10,000.
- $10,000 - $19,999
- $20,000 - $29,999
- $30,000 - $39,999
- $40,000 - $49,999
- $50,000 - $59,999
- $60,000 - $69,999
- $70,000 - $79,999
- $80,000 - $89,999
- $90,000 - $99,999
- $100,000 - $149,999
- More than $150,000.

Q8a. Is your DBE a secondary (e.g., moonlighting) job/career/business?

This question was not displayed to the respondent.

Q8b. Would you please describe any other reasons of earning less than $10,000 from your DBE business?

This question was not displayed to the respondent.

Q9.
Note: For the remainder of the survey, please respond regarding your current firm that is a certified DBE.

How did you become the business owner of your current DBE?

- I started up this business (entrepreneur)
- I took over this business from my parents or relatives (family members)
- I acquired this business from someone who is not a direct relation (someone who is not a family member)
- Other

Q10. Please indicate your business entity type (legal structure/status).

- Sole Proprietorship
- Partnership
- Corporation
- S-Corporation
- Limited Liability Company (LLC)
- Other

Q11. Please provide information about your business.

Your Business Name	
Use one word or a phrase to describe your main services or products	
Total number of employees nationwide	
Total number of offices nationwide	
Total number of DBE certified states	
Number of years as a certified DBE (current firm)	

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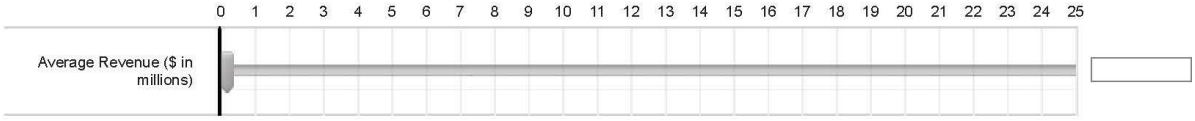
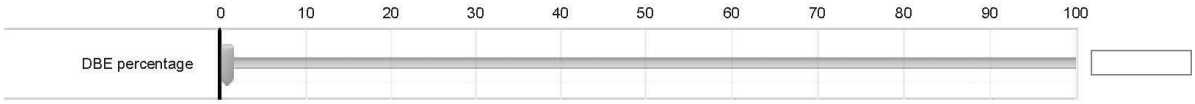
Q12. Please estimate your average annual revenue for the past three years ($ in millions).



Q13. Please estimate the average percentage in dollars of DBE contracts in your revenue above.



O1. Besides DBE certification, is your business holding any other certifications below?

Note:
- You may be eligible for multiple certifications. However, you have to hold a certification from an organization to choose certifications below.

- ☐ Small Business Enterprise (SBE)
- ☐ Women Owned Small Business (WOSE)
- ☐ Minority Owned Small Business (MOSE)
- ☐ Minority Business Enterprise (MBE)
- ☐ Women Business Enterprise (WBE)
- ☐ Veteran-Owned Small Business (VBE or VOSB)
- ☐ Service-Disabled Veteran-Owned Small Business (SDV, DVB, or DVBE)
- ☐ HUBZone Business
- ☐ Local Business Enterprise (LBE)
- ☐ Community Based Enterprise (CBE)
- ☐ None of the above
- ☐ Other

O2. In general, how useful the certification to your business?

	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful

O3. Please provide any additional comments about the entire survey or any information you would like to share with the researcher.

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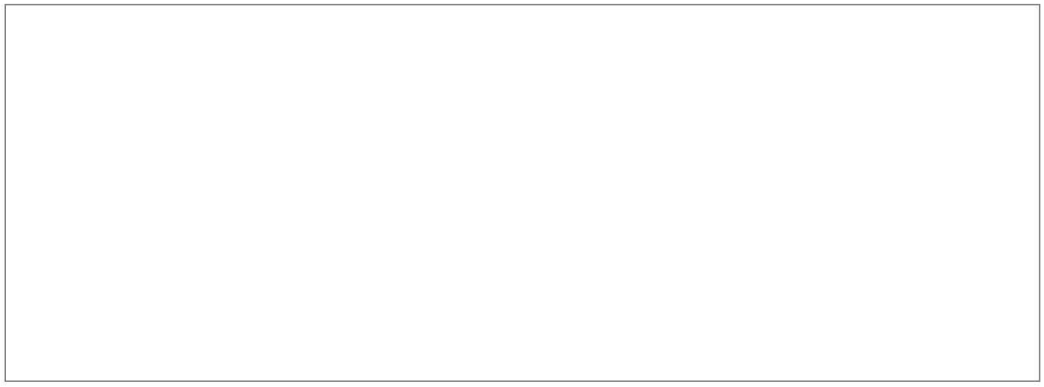

Q14. Is your business ready, willing, and able to work on a DOT contract? Please select ALL that applies.

- ☐ Ready
- ☐ Willing
- ☐ Able
- ☐ None of the above

Q15. Have you worked on a DOT contract in the past ten years?

- ○ Yes
- ○ No

Q15a. How often (on average) do you work on DOT projects as a prime contractor/consultant in a year?

This question was not displayed to the respondent.

Q15b. How often (on average) do you work on DOT projects as a subcontractor/subconsultant in a year?

This question was not displayed to the respondent.

Q16. Which business area below best describes your DBE?

- ○ Construction contracting
- ○ Engineering consulting
- ○ Local trucking
- ○ Others

Q17. Please indicate how you feel about the success of your business.

Not at all successful	Slightly successful	Moderately successful	Very successful	Extremely successful
○	○	○	○	○

Q18. Please indicate the level of growth/maturity/development of your business.

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Far below average	Somewhat below average	Average	Somewhat above average	Far above average
○	○	○	○	○

Q17o. Please select ALL that prevent your DBE from being ready, willing, or able.

This question was not displayed to the respondent.

Q18o. Please select ALL that describe why you are not getting any DOT contract (e.g., federal-assisted contracts).

This question was not displayed to the respondent.

Q19o. What motivated or inspired you to become a certified DBE?

This question was not displayed to the respondent.

Q20o. How does the DBE identity or certification influence your business?

This question was not displayed to the respondent.

Q19. Please rate the degree you are experiencing the following business challenges

	Not Applicable	No challenge	Minor challenge	Somewhat challenge	Major challenge
Finding contracting opportunities in general	○	○	○	○	○
Diminished opportunities because of my race or gender	○	○	○	○	○
Marketing my business and networking with others	○	○	○	○	○
Finding capital such as loans and credits	○	○	○	○	○
Getting surety bonds or increasing bonding capacity	○	○	○	○	○
Managing cash flows and preparing financial statements	○	○	○	○	○
	Not Applicable	No challenge	Minor challenge	Somewhat challenge	Major challenge
Using electronic bidding systems or technology	○	○	○	○	○
Navigating project letting and bidding processes	○	○	○	○	○
Finding new or retaining existing skilled workers	○	○	○	○	○
Having or working with someone who has language barriers	○	○	○	○	○
Bias and/or discrimination from prime contractors	○	○	○	○	○
Bias and/or discrimination from DOT staff	○	○	○	○	○
	Not Applicable	No challenge	Minor challenge	Somewhat challenge	Major challenge
Strong competition as a result of DBE overconcentration	○	○	○	○	○
Delayed payments or withheld retainages	○	○	○	○	○
Bid shopping by primes after contract award	○	○	○	○	○
Managing and maintaining relationship with contractors/consultants/clients/subcontractors/subconsultants.	○	○	○	○	○
Other, please explain [ ]	○	○	○	○	○

Q20. How strongly do you agree or disagree with the following statements?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree

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DBEs struggle with issues of being small, compounded with the disadvantaged status.	○	○	○	○	○
Being a certified DBE increases contracting opportunities.	○	○	○	○	○
DBEs deliver competitive and quality products or services.	○	○	○	○	○
DBEs are sometimes unable to complete work on time or schedule.	○	○	○	○	○
DBEs are sometimes unable to perform work that meets project specifications.	○	○	○	○	○
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
There is no incentive for primes to use me unless they are required by the DBE program.	○	○	○	○	○
Primes are not eager to work with DBEs and reluctant to use new DBEs	○	○	○	○	○
Being a certified DBE, I will lose the protection from discrimination if I move out of (graduate from) the DBE program.	○	○	○	○	○
The old boy network still exists and prevents DBEs from networking	○	○	○	○	○
Large DBEs overshadow small DBEs making it difficult for small or new DBEs to grow.	○	○	○	○	○
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
The DBE program ensures nondiscrimination in the award and administration of federal-assisted contracts	○	○	○	○	○
The DBE program levels the playing field for all enterprises	○	○	○	○	○
Supportive services remove barriers for DBEs	○	○	○	○	○
Supportive services help DBEs develop their business	○	○	○	○	○
Joining associations (e.g., AGC, ASCE) has substantial benefits.	○	○	○	○	○

Q21. Have you used any supportive service from the Disadvantaged Business Enterprise Supportive Services program since your initial certification?

- ○ Never used and would not use any in the future
- ○ Never used but would use some in the future
- ○ Used some but would not use any in the future
- ○ Used some and would use more in the future

Q22.
Please rank the impact level (from the most to the least) of supportive service delivery methods.

- Online: recording
- Online: live streaming
- In-person: classes, courses, workshops
- In-person: conferences
- In-person: on-job-site

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Other, please explain

21a. Would you please explain reasons of never used and would not use any in the future?

This question was not displayed to the respondent.

21b. Would you please explain what supportive services would you like to use in the future?

This question was not displayed to the respondent.

21c. Would you please describe the supportive services you used and explain reasons of would not used any in the future?

This question was not displayed to the respondent.

Q23. Please indicate the usefulness of the following business-related supportive services.

	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Overall supportive services in marketing	○	○	○	○	○	○
Business cards	○	○	○	○	○	○
Website development	○	○	○	○	○	○
Market analysis	○	○	○	○	○	○
Capabilities statement	○	○	○	○	○	○
Overall supportive services in financial	○	○	○	○	○	○
Access to capital (loans or credits)	○	○	○	○	○	○
	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Bonding assistance	○	○	○	○	○	○
Balance sheets	○	○	○	○	○	○
Income statements	○	○	○	○	○	○
Cash flow management	○	○	○	○	○	○
Overall supportive services in accounting	○	○	○	○	○	○
Payroll (QuickBooks)	○	○	○	○	○	○
Tax planning and returns	○	○	○	○	○	○
	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Overall supportive services in professional skills	○	○	○	○	○	○
Communication	○	○	○	○	○	○
Teamwork & interpersonal skills	○	○	○	○	○	○
Leadership & work ethic	○	○	○	○	○	○
Flexibility & adaptability	○	○	○	○	○	○
Overall supportive services in operation and management	○	○	○	○	○	○
Developing vision and mission	○	○	○	○	○	○
	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Preparing a business plan	○	○	○	○	○	○
Business analysis tools (SWOT, PEST)	○	○	○	○	○	○

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	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
(Sub)Contractors/consultants management	○	○	○	○	○	○
Supply chain and mobilization	○	○	○	○	○	○
Overall supportive services in administration	○	○	○	○	○	○
Organizational structure	○	○	○	○	○	○
Overall supportive services in human resources	○	○	○	○	○	○
	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Hiring new employees	○	○	○	○	○	○
Retaining existing employees	○	○	○	○	○	○
Workforce development	○	○	○	○	○	○
Overall Supportive Services in investment	○	○	○	○	○	○
Property, Plant, and Equipment (PP&E)	○	○	○	○	○	○
Other [ ]	○	○	○	○	○	○

23a. Please provide additional comments or discussions about business-related supportive services.

Q24. Please indicate the usefulness of the following engineering-related supportive services.

	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Overall supportive services in getting professional licenses and certifications	○	○	○	○	○	○
Certified Professional Constructor (CPC)	○	○	○	○	○	○
Professional Engineer (PE)	○	○	○	○	○	○
Professional Surveyor (PS)	○	○	○	○	○	○
Overall supportive services in insurance	○	○	○	○	○	○
Company and office space	○	○	○	○	○	○
Vehicle and equipment	○	○	○	○	○	○
	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Overall supportive service in technical analysis	○	○	○	○	○	○
Traffic analysis	○	○	○	○	○	○
Environmental analysis	○	○	○	○	○	○
Structural analysis	○	○	○	○	○	○
Overall supportive services in design by infrastructure type	○	○	○	○	○	○
Buildings	○	○	○	○	○	○
Bridges	○	○	○	○	○	○

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	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Roads	○	○	○	○	○	○
Overall supportive services in design by material type	○	○	○	○	○	○
Steel	○	○	○	○	○	○
Concrete	○	○	○	○	○	○
Masonry	○	○	○	○	○	○
Wood	○	○	○	○	○	○
Overall supportive services in temporary supports	○	○	○	○	○	○

	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
False support	○	○	○	○	○	○
Cofferdam	○	○	○	○	○	○
Overall supportive services in software and technology	○	○	○	○	○	○
AutoCAD, Revit, or GIS	○	○	○	○	○	○
Virtual design and construction	○	○	○	○	○	○
Digital document management systems	○	○	○	○	○	○
Overall supportive services in continuing education	○	○	○	○	○	○

	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Professional Development Hour (PDH)	○	○	○	○	○	○
Overall supportive services in sustainability	○	○	○	○	○	○
Leadership in Energy and Environmental Design (LEED)	○	○	○	○	○	○
Overall supportive services in other technical skills	○	○	○	○	○	○
Problem solving	○	○	○	○	○	○
Analytical skills	○	○	○	○	○	○
Critical thinking	○	○	○	○	○	○

24a. Please provide additional comments or discussions about engineering-related supportive services

Q25. Please indicate the usefulness of the following construction-related supportive services.

	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Overall supportive services in bidding assistance	○	○	○	○	○	○
Plan and specification reading	○	○	○	○	○	○

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Quantity and cost estimating	○	○	○	○	○	○
Proposal (bid, price, and qualification) preparation	○	○	○	○	○	○
Mock bidding interviews	○	○	○	○	○	○
Overall supportive services in bonding assistance	○	○	○	○	○	○
Financial statement preparation	○	○	○	○	○	○
	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Overall supportive services in safety	○	○	○	○	○	○
OSHA training	○	○	○	○	○	○
Overall supportive services in project scheduling and cost control	○	○	○	○	○	○
Critical Path Method	○	○	○	○	○	○
Burn rate	○	○	○	○	○	○
Overall supportive services in contract administration	○	○	○	○	○	○
Record keeping	○	○	○	○	○	○
	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Contract compliance	○	○	○	○	○	○
Overall supportive services in quality control and assurance	○	○	○	○	○	○
Quality management	○	○	○	○	○	○
Quality improvement	○	○	○	○	○	○
Overall supportive services in job site management	○	○	○	○	○	○
On-job-site training	○	○	○	○	○	○
Labor, material, and equipment	○	○	○	○	○	○
	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Storm water (SWPPP)	○	○	○	○	○	○
Traffic control (flagging)	○	○	○	○	○	○
Material and product testing	○	○	○	○	○	○
Field inspection	○	○	○	○	○	○
Overall supportive services in special topics	○	○	○	○	○	○
Project delivery methods	○	○	○	○	○	○
Pre-construction services	○	○	○	○	○	○
	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Equipment package optimization	○	○	○	○	○	○
Law, policy, and regulation	○	○	○	○	○	○
Dispute resolution	○	○	○	○	○	○

25a. Please provide additional comments or discussions about construction-related supportive services

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Q26. Please indicate the usefulness of the following other supportive services.

	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Overall supportive services about the DBE program	○	○	○	○	○	○
Outreach and networking	○	○	○	○	○	○
Email-blasts and newsletters	○	○	○	○	○	○
Certification requirements	○	○	○	○	○	○
DBE program introduction/orientation	○	○	○	○	○	○
Financial assistance (loans)	○	○	○	○	○	○
Unbundling large contracts	○	○	○	○	○	○
	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Prompt pay provision	○	○	○	○	○	○
Release of retainage	○	○	○	○	○	○
Overall supportive services about relevant programs	○	○	○	○	○	○
Business development program	○	○	○	○	○	○
Mentor-protege program	○	○	○	○	○	○
Apprenticeship program	○	○	○	○	○	○
Targeted assistance program	○	○	○	○	○	○
	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Local assistance program	○	○	○	○	○	○
Annual conference	○	○	○	○	○	○
One-on-one assistance	○	○	○	○	○	○
Tuition reimbursement	○	○	○	○	○	○
Collaboration with other organizations (AGC, ASCE, SBA)	○	○	○	○	○	○

26a. Please provide additional comments or discussions about other supportive services

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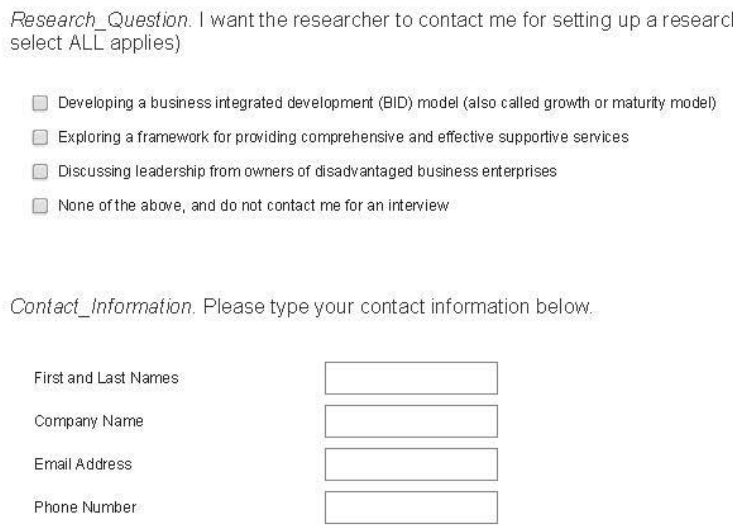

Research_Question. I want the researcher to contact me for setting up a research interview about (Please select ALL applies)

- ☐ Developing a business integrated development (BID) model (also called growth or maturity model)
- ☐ Exploring a framework for providing comprehensive and effective supportive services
- ☐ Discussing leadership from owners of disadvantaged business enterprises
- ☐ None of the above, and do not contact me for an interview

Contact_Information. Please type your contact information below.

First and Last Names	
Company Name	
Email Address	
Phone Number	

DBE Survey Distribution Statistics through Qualtrics

Initial Survey Invitations to 24,934 DBEs.

- 24730 Emails Sent
- 204 Emails Failed
- 1336 Surveys Started
- 943 Surveys Finished
- 1523 Emails Bounced
- 6 Duplicate Emails
- 62 Complaints

First Email Reminder

- 24342 Emails Sent
- 204 Emails Failed
- 1548 Emails Bounced
- 6 Duplicate Emails
- 23 Complaints

Second Email Reminder

- 24952 Emails Sent
- 209 Emails Failed
- 1595 Emails Bounced
- 5 Duplicate Emails
- 25 Complaints

Initial Survey Invitations to 10,464 DBEs

- 10448 Emails Sent
- 16 Emails Failed
- 635 Surveys Started
- 434 Surveys Finished
- 654 Emails Bounced
- 4 Duplicate Emails
- 17 Complaints

First Email Reminder

- 10172 Emails Sent
- 16 Emails Failed
- 657 Emails Bounced
- 4 Duplicate Emails
- 8 Complaints

Second Email Reminder

- 9938 Emails Sent
- 16 Emails Failed
- 673 Emails Bounced
- 4 Duplicate Emails
- 15 Complaints

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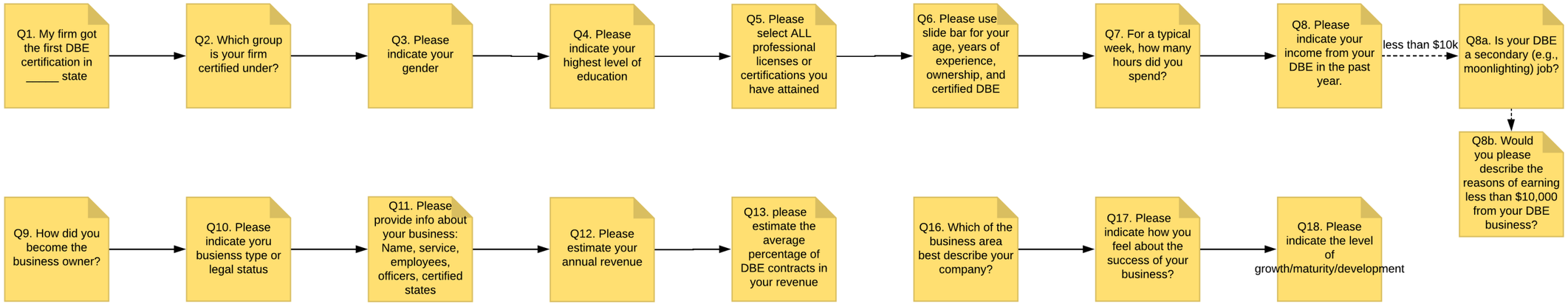

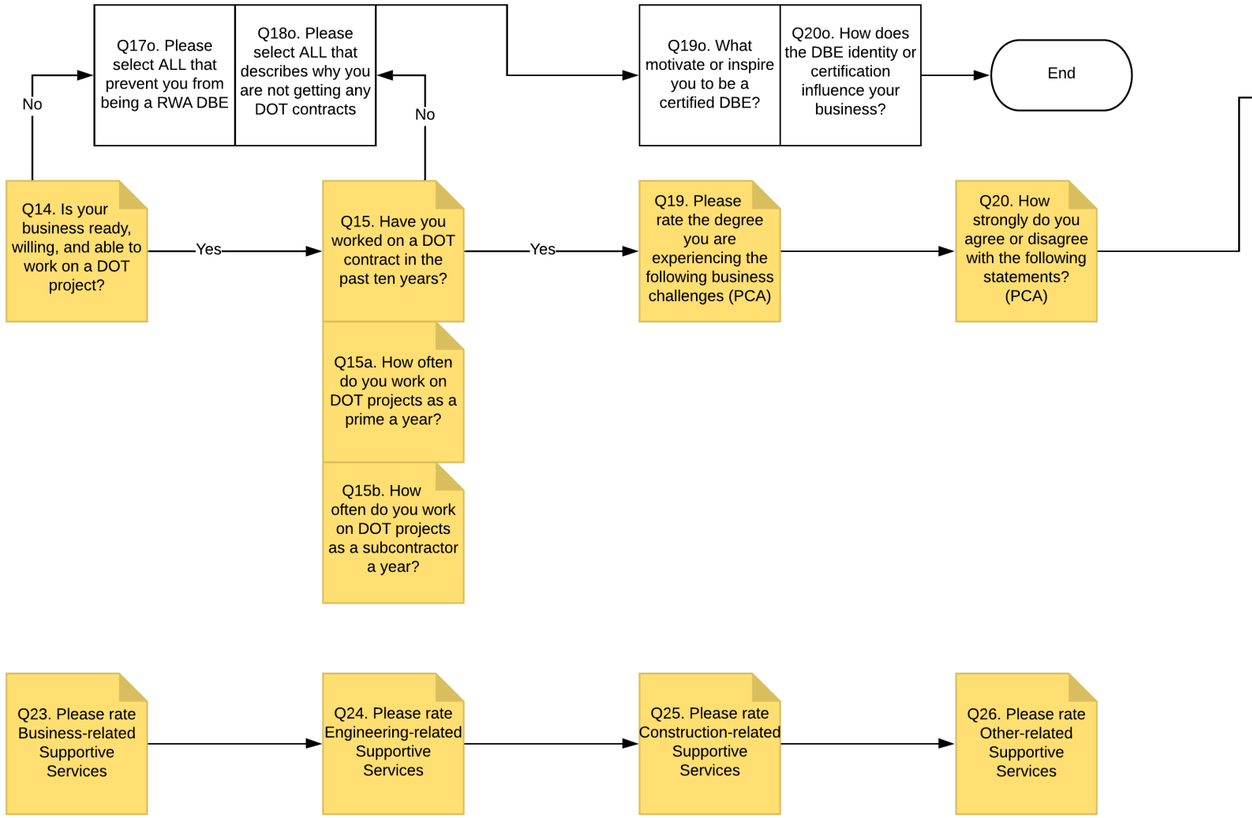

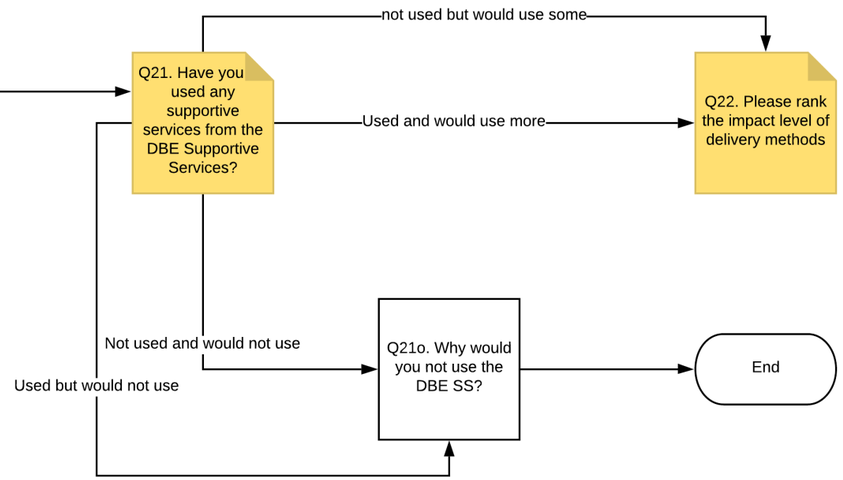

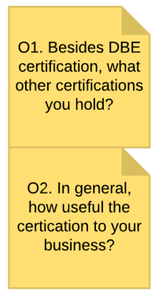

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APPENDIX D. DBELO SURVEY DESIGN

Introduction.

Welcome to the Research Study about Disadvantaged Business Enterprises

I am a researcher working with a professor at Iowa State University and Institute for Transportation on a study related to Disadvantaged Business Enterprises (DBEs). We are inviting you because we identified you as the Disadvantaged Business Enterprise Liaison Officer (DBELO) in your state. Your participation in this study should take less than 20 minutes. Your honest feedback will help us better understand DBEs and DBE programs, inform policymakers on future regulatory changes, and improve the experience of DBEs and the quality of DBE programs. We need your help to complete this critical study.

The Institutional Review Board (IRB) at Iowa State reviewed and approved this study in February 2019. All responses will remain anonymous and be confidential to the IRB approved researchers. Your participation is voluntary, and we greatly appreciate your assistance and support. If you want to contact the researcher for questions, please email Mr. Hongtao Dang at hitdang@iastate.edu.

The researcher assumes the Disadvantaged Business Enterprise Liaison Officer (DBELO) has the most knowledge about DBEs and DBE programs or is able to print this survey and collect information from various staff. Then, answer the questions through collective responses. If a DBELO is unavailable, any staff from the DBE program can represent the DBELO and fill the survey through collective insights.

Download a PDF version of the survey: State DOT DBELO Survey PDF version

More information about the study is available in the Informed Consent Form (ICF) through the link below. Please read the ICF and choose "I agree to participate after reading the ICF" to begin the survey.
Link: Informed Consent Form for the Research Study about Disadvantaged Business Enterprises

- (●) I agree to participate after reading the ICF.
- ( ) I decline to participate after reading the ICF.

Q1.
Please select a state from the drop-down list below.

I am the DBELO or represent the DBELO from [Iowa ▼]

Q2.
States use different approaches (i.e., race-conscious, race-neutral, or mixed approaches) to achieve DBE goals in federal-assisted contracts. Race-conscious means setting a DBE contract goal on each federal-assisted project. Contract compliance ensures awarded contractors use DBEs and meet the goal. Race-neutral means promoting and supporting the use of DBEs through various means and methods without setting a DBE contract goal on a project. Government agencies (e.g., DBELO) and prime contractors (i.e., non-DBEs) try to include and use DBEs through outreach and networking, unbundling large contracts, and supportive services.

Which is the dominant or preferred approach in your state to achieve DBE goals in federal-assisted contracts?

- ( ) Race-conscious approach
- ( ) Race-neutral approach
- ( ) A mixed (both race-conscious and neutral) approaches
- ( ) Other, please explain [ ]

Q3.
If your state does not split the DBE goal, please indicate your goal in either race-conscious or race-neutral and leave the other one blank. If data is not available, please leave it blank.

What are your DBE goals in 2018?

Three-year DBE goal (%)	
Race-conscious goal (%)	
Race-neutral goal (%)	
DBE goal achieved (%)	

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Race-conscious goal achieved (%)	
Race-neutral goal achieved (%)	
Goal achieved by DBE prime contractors/consultants (%)	
Goal achieved by DBE subcontractors/subconsultants (%)	

Q4. For your DBE program, please tell us about the number of current DBE staff and estimate their total years of experience working with DBEs.

Number of full-time staff	
Number of part-time staff	
Number of vacant positions	
Experience from full-time staff (years)	
Experience from part-time staff (years)	

Q5. How often is the DBE directory updated?

- ○ Daily
- ○ Weekly
- ○ Monthly
- ○ Quarterly
- ○ Other

Q6. How strongly do you agree or disagree with the following statements?

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Federal regulations (CFR 49 Part 26) subjects to many different interpretations.	○	○	○	○	○
The DBE program objectives are followed and enforced by setting, tracking, and achieving DBE goals.	○	○	○	○	○
The DBE program ensures nondiscrimination	○	○	○	○	○
The DBE program creates a level playing field	○	○	○	○	○
The DBE program helps remove barriers and promotes the use of DBEs.	○	○	○	○	○
The DBE supportive services program assists DBEs to develop their business	○	○	○	○	○
The DBE program has complaints and legal challenges	○	○	○	○	○

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
The DBE program should focus more on the objectives.	○	○	○	○	○
The DBE program should focus less on meeting the goals.	○	○	○	○	○
Meeting the goal does not guarantee meeting the objectives	○	○	○	○	○
Neither exceeding nor failing to meet the goal means an inappropriate setting of the three-year goal.	○	○	○	○	○
Both Newly certified DBEs and successful DBEs moved out of (graduated from) the DBE program can significantly influence the achievability of DBE goals.	○	○	○	○	○
Setting a DBE contract goal is challenging on a project and involves considations of many factors (e.g., locations, DBE availability) and insights from many perspectives (e.g., contractors, DBEs).	○	○	○	○	○
Managing DBE contract (race-conscious) goals on all federal-assisted contracts requires a substantial effort.	○	○	○	○	○

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Overall, the DBE program is effective.	○	○	○	○	○
The DBE program has adequate staff	○	○	○	○	○
Each DBE staff is well trained	○	○	○	○	○
The state DOT support and advocate the DBE program	○	○	○	○	○
DBE staff turnover is an issue	○	○	○	○	○

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	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
The DBE program receives sufficient funding and resources	○	○	○	○	○
Multiple certification agencies (e.g., state, local) sometime confuse DBEs	○	○	○	○	○
The DBE program needs improvements	○	○	○	○	○
Need to educate DOT staff about the DBE program	○	○	○	○	○
Need to educate prime contractors about the DBE program	○	○	○	○	○
Need to educate DBEs about the DBE program	○	○	○	○	○
Need to recognize successful DBEs	○	○	○	○	○
Need to recognize prime contractors with excellent DBE utilization.	○	○	○	○	○

Q6_Comments. Please provide additional comments or discussions about DBE programs (optional)

Q7. Please drag, drop, and rank ALL items on the left into the categories on the right.

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Items	Core practices and major efforts	Common practices but not a major effort	Something we do if needed	Something we do with additional staff or resources	Something we do not do
Advocate objectives of the DBE program.					
Approve DBE certification through application review and on-site visit/interview.					
Review and approve DBE renewals					
Conduct disparity or availability studies.					
Set and achieve (state-level, three-year) DBE goals.					
Set and attain (project-level, one-time) DBE contract goals.					
Maintain DBE directory and relevant rosters.					
Enforce prompt pay provision.					
Inspect commercial useful functions.					
Monitor contract compliance					
Evaluate good faith efforts.					
Outreach and public presents.					
Prepare DBE guide, manual, or reports.					
Investigate complaints or noncompliance					
Develop standardized forms, checklist, and procedures for DBE certification and administration.					
Provide periodical training to all DOT staff engaged in the DBE program.					

Q8. Please discuss any other items that are missing from the list above.

Q9. Please drag, drop, and rank (if needed) the following administrative practices that support DBEs.

Note:
This question is asking about the administrative practices from the DBE program that support DBEs. Question 13 will be asking about the supportive services from the DBE supportive services program. Supportive Services include but not limited to marketing, business development, and technical and financial assistance. Both mentor-protege and business development programs are assumed to be a part of supportive services.

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Items	Used and would continue to use in the future	Used but would not use in the future	Not used but would use in the future	Not used and would not use in the future
Assist DBEs with certifications and renewals				
Provide bidders list to DBEs				
Hold pre-bid and pre-letting meetings				
Unbundle large contracts				
Release (or require no) retainage on contracts				
Incentivise contractors for using DBEs				
Target large contractors to commit DBE participation				
Provide financial assistance through loan mobilization program				
Waive or reduce bonding requirement for DBEs				
Arrange solicitations or provide contracts (not a set-aside) to DBEs				
Review and approve terminations of non-performing DBEs				
Collaborate with neighboring state on DBE participations				
Foster relationship building between primes and DBEs.				

Q10. Please discuss any other items that are missing from the list above.

Q11. What was the annual budget for DBE Supportive Services in 2018?

Note:

- If budgets are different by more than 50% each year, please provide the average of the last three years (i.e., 2016, 2017, and 2018).

Federal Funding	0
State Funding	0
Others	0
Total	0

Q12. For your DBE Supportive Services program, please tell us the number of current staff and estimate their total years of experience working with DBEs.

Number of full-time staff inside DOT	
Number of part-time staff inside DOT	
Experience of full-time staff inside DOT (years)	

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Experience of part-time staff inside DOT (years)	
Number of vacant positions inside DOT	
Number of full-time staff outside DOT	
Number of part-time staff outside DOT	
Experience of full-time staff outside DOT (years)	
Experience of part-time staff outside DOT (years)	

Q13. Please rank the impact level (from the most to the least) of supportive service delivery methods.

Online: recording
Online: live streaming
In-person: classes, courses, workshops
In-person: conferences
In-person: on-job-site
Other, please explain:

Q14. Please list all organizations you collaborate or contract with for providing supportive services.

Q15. Please select ALL supportive services that you have provided in the past (i.e., last three years) or wish to offer in the future (i.e., next three years).

	Provided in the past (i.e., last three years)		Wish to offer in the future (i.e., next three years)	
	Yes	No	Yes	No
DBE program introduction/orientation	○	○	○	○
Certification and contract compliance	○	○	○	○
Doing businesses with (navigating) DOT	○	○	○	○
startups and entrepreneurship	○	○	○	○
Business plan preparation	○	○	○	○
Website development	○	○	○	○
Marketing (capabilities statement)	○	○	○	○
Networking (meet-greet, meet primes)	○	○	○	○
	Yes	No	Yes	No
Accounting, payroll, and bookkeeping	○	○	○	○
Tax planning, deductions, and returns	○	○	○	○
Cash flow management	○	○	○	○
Financial and capital assistance	○	○	○	○
One-on-one assistance (business/technical)	○	○	○	○
Plan and specification reading	○	○	○	○
Quantity and cost estimating	○	○	○	○
Mock bidding workshops	○	○	○	○
	Yes	No	Yes	No
Bidding and proposal assistance	○	○	○	○
Bonding and insurance assistance (surety bonds)	○	○	○	○
Safety training (OSHA)	○	○	○	○
Traffic control (flagging)	○	○	○	○

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Technology/software (QuickBooks, Bidx)	○	○	○	○
Annual DBE workshop/conference	○	○	○	○
On-jobsite-training (OJT)	○	○	○	○
Dispute resolution and legal assistance	○	○	○	○
	Yes	No	Yes	No
Tuition reimbursement	○	○	○	○
Business development program	○	○	○	○
Mentor-protege program	○	○	○	○
Targeted assistance program	○	○	○	○
Apprenticeship program	○	○	○	○
Local assistance program	○	○	○	○

Q16. Please elaborate your current supportive services or discuss any other supportive services that are missing from the list above.

Q17. Please indicate the usefulness of each of the following supportive services.

	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful

Q18. Please indicate how frequently each of the following supportive service is provided.

Note:
- If supportive services are accessible online with live streaming, the frequency is the times of the offered live streaming.
- If supportive services are accessible online with recording, the frequency is nine or more.

	One or Two	Three or Four	Five or Six	Seven or Eight	Nine or more or Accessible Online Recording

Q19. Please indicate how many location(s) a supportive service is provided at a time.

Note:
- If supportive services are accessible online regardless of live streaming or recording, the number of locations is assumed to be "five or more locations or accessible online".

	One	Two	Three	Four	Five or more Locations or Accessible Online

Q20. How would you rank the priority of supportive services that are going to be offered in the future (i.e., next three years)?

Q21. Please provide the number of certified DBEs in each group based on the information in your DBE directory.

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Caucasian (White) Women	0
Black Americans	0
Hispanic Americans	0
Native Americans	0
Asian-Pacific Americans	0
Subcontinent Asian Americans	0
Others, designated by Small Business Administration	0
Total	0

Q22. Does your DBE program have information on the total number of ready, willing, and able (RWA) DBEs?

- ○ Yes
- ○ No

Q23. Does your DBE program have successful DBEs moved out of (graduated from) the program?

- ○ Yes
- ○ No

Q22a. What are numbers of ready, willing, and able (RWA) DBEs in the following groups?

This question was not displayed to the respondent.

Q22b. What are numbers of RWA DBEs in the following business types?

This question was not displayed to the respondent.

Q23a. What were numbers of successful DBEs from the groups below moved out of (graduated from) the DBE program in the past ten years?

This question was not displayed to the respondent.

Q23b. What were numbers of successful DBEs from the business types below moved out of (graduated from) the DBE program in the last ten years?

Note:
- If the information is not available, please provide your best estimate.
- Please exclude DBEs who successfully moved out of the DBE program but later re-certified in the DBE program.

This question was not displayed to the respondent.

Q23c. Please rank the reasons for DBEs moving out of (graduating from) the DBE program.

This question was not displayed to the respondent.

Q24. How strongly do you agree or disagree with the following statements?

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Most DBEs are small in size	○	○	○	○	○
Most DBEs face discrimination and oppression	○	○	○	○	○
Most DBEs have limited access to capital (i.e., loans)	○	○	○	○	○
Most DBEs struggle with cash flow management	○	○	○	○	○
Most DBEs have no or little bonding capacity	○	○	○	○	○

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	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Most DBEs need assistance in marketing and networking	○	○	○	○	○
Most DBEs operate in a local region	○	○	○	○	○
Most DBEs are subcontractors	○	○	○	○	○
Most DBEs provide marginal or nontraditional services	○	○	○	○	○
Most DBEs lack of experience managing a business	○	○	○	○	○
DBEs lose protection from discrimination when moved out of (graduated from) the DBE program.	○	○	○	○	○
DBEs are more sensitive (less resilient) to external factors such as policies, economic conditions, or inflation.	○	○	○	○	○

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Many certified DBEs but few ready, willing, and able DBEs participate in DOT contracts.	○	○	○	○	○
Some DBEs bid outside of their expertise and capabilities	○	○	○	○	○
Potential reverse discrimination exists for small non-DBE contractors/consultants who are competing with DBEs.	○	○	○	○	○
We have DBE overconcentration in some NAICS codes	○	○	○	○	○
We have DBE shortage in some NAICS codes	○	○	○	○	○
We spend a great effort in matching DBEs with prime contractors	○	○	○	○	○

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Prime contractors are not willing to use new DBEs	○	○	○	○	○
Prime contractors are not willing to use/work with a qualified DBEs unless they are required to use a certified DBE by contract.	○	○	○	○	○
Prime contractors lack commitment, cooperation, or follow-through in working with DBEs	○	○	○	○	○
Large DBEs overshadow small or newly emerging DBEs, making it difficult to grow.	○	○	○	○	○
Fraudulent DBEs diminish opportunities for legitimate DBEs	○	○	○	○	○
Old-boy networks still exist and prevent DBEs from getting contracting opportunities.	○	○	○	○	○

Q24_Comments. Please provide additional comments or discussions about DBEs or Non-DBEs (contractors/consultants)

R1. Please provide the contact information of three ready, willing and able (RWA) DBEs who have been subcontractors/subconsultants and that you recommend for conducting research interviews.

First & Last Names

Company Name

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Email Address	
Phone Number	
First & Last Names	
Company Name	
Email Address	
Phone Number	
First & Last Names	
Company Name	
Email Address	
Phone Number	

R2. Please provide the contact information of three RWA DBEs who have been prime contractors/consultants and that you recommend for conducting research interviews.

First & Last Names	
Company Name	
Email Address	
Phone Number	
First & Last Names	
Company Name	
Email Address	
Phone Number	
First & Last Names	
Company Name	
Email Address	
Phone Number	

R3. Please provide the contact information of three DBEs who have moved out of (graduated from) the DBE program and that you recommend for conducting research interviews.

First & Last Names	
Company Name	
Email Address	
Phone Number	
First & Last Name	
Company Name	
Email Address	
Phone Number	
First & Last Names	
Company Name	
Email Address	
Phone Number	

R4. Please provide the contact information of three non-DBE contractors/consultants who have worked extensively with DBEs and that you recommend for conducting research interviews.

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First & Last Names

Company Name

Email Address

Phone Number

First & Last Name

Company Name

Email Address

Phone Number

First & Last Names

Company Name

Email Address

Phone Number

R5. Please provide any additional comments about the entire survey or any additional information that you want to share with the researcher.

Note: Only four states responded to the DBELO survey. The author used survey responses for validation and as supplementary data. Because of the low response rate, the author decided not to use the data for any statistical analysis.

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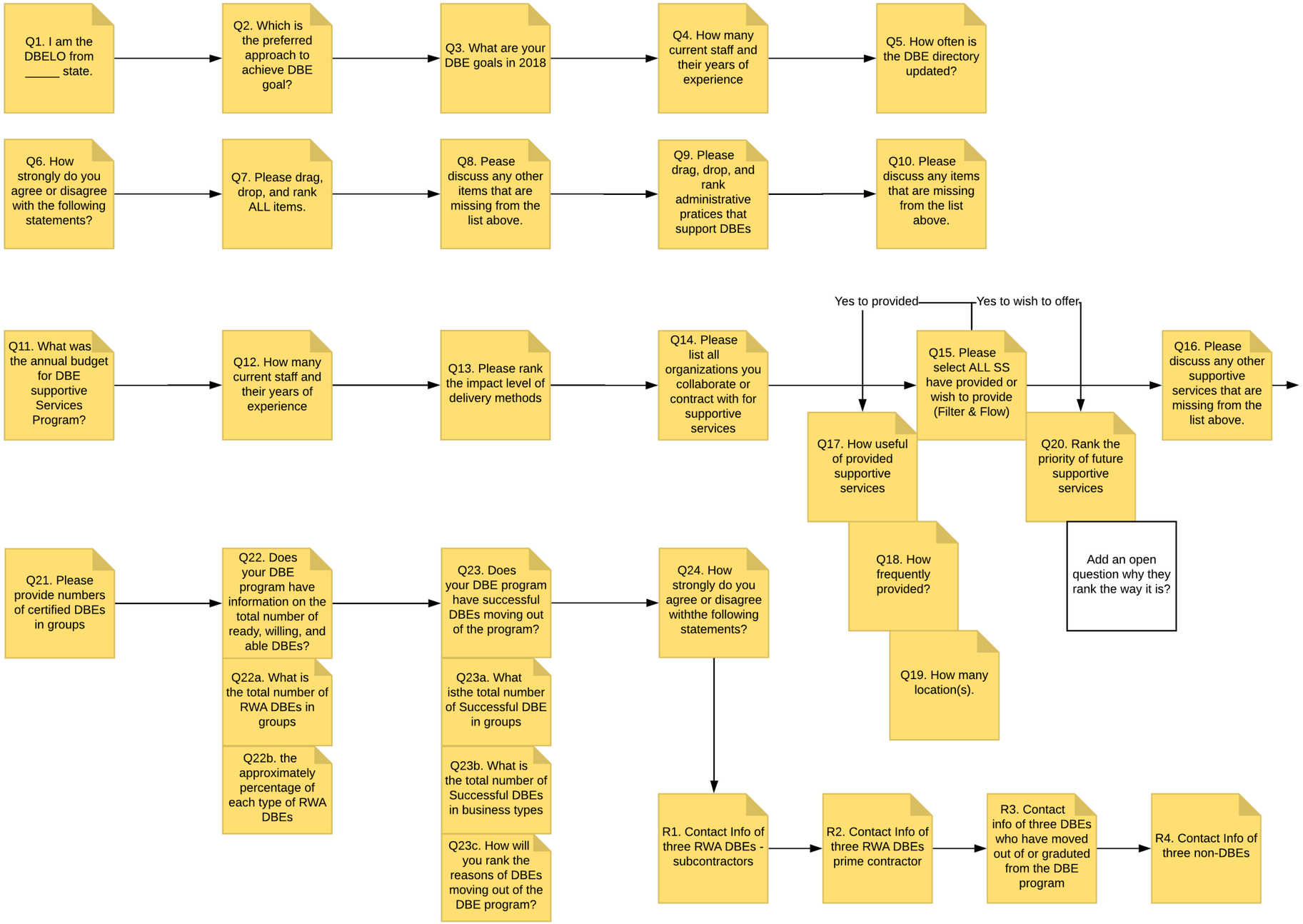

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APPENDIX E. INTERVIEW PROTOCOL FOR DBE PROGRAMS

Hongtao Dang DBE and Its Programs 2019

Semi-Structured Interview Guide

The research study focuses on disadvantaged business enterprises (DBEs) in construction and engineering services under Federal Highway Administration (mainly roads and bridges). Your responses will NOT attribute to your state and will only be released in summary form.

Introduction

- Roles, Responsibilities, and Experience

DBE (15-20 minutes)

- DBE Population, Ethnicity, Business Types (NAICS)
- Ready, Willing, and Able DBEs
- Successful Stories
- Characteristics and Needs

DBE Program (15-20 minutes)

- Administration and Collaboration
- Race-Conscious and Neutral Measures
- Commitment and Attainment
- What's working and needing future improvement
- Business Development Program

DBE Supportive Services Program (15-20 Minutes)

- Outreach/Networking
  - Newsletters/Blogs
  - Speed Networking Event
- Training/Workshop
  - Annual DBE Workshop
  - Business/Management
  - Engineering/Technical
- Mentor-Protégé Program
- Other Effective/Demanding Supportive Services

Closure

1. Research needs
2. Anything else

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Topics we will NOT discuss unless participant want to

- Unified Certification Program (UCP)
- Commercially Useful Function (CUF)
- Overconcentration in work types
- Prompt pay provision
- Legal issues or frauds

Topics we will not discuss in depth unless participant want to

- Disparity and Availability Study
- Good Faith Efforts in contracts, DBE termination, or DBE replacement
- Innovative/Alternative Contracting Methods

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Hongtao Dang DBE and Its Program 2019
Semi-Structured Interview Protocol

Agency: _____ Department of Transportation Pseudonym: _____
Informed Consent Form _____ (Check for completion)

Introduction (my name, research objectives, inspirations)

1. What is your job title and how do you describe your responsibilities?
    a. What are your interactions with DBEs?
2. What is your background and how long have you been working on this job?
    a. How did you choose this job initially?
3. Do you have any questions before we begin?

[Start recording]

DBE (15-20 minutes). Based on your experience and interactions with DBEs

1. How would you describe the characteristics of DBEs in your state?
2. What are the common questions/complaints/issues you heard from DBEs?
3. Who are the largest/successful DBEs? What are their stories?
4. Who are the smallest/challenging DBEs? Why are so?

DBE Program (15-20 minutes)

1. Would you please briefly describe the staff member's responsibilities and administrative reporting relationships for the DBE program?
2. How would you or your team members manage the DBE program along with contract compliance and equal opportunity offices (the collaboration of different offices)?
3. How do you use race-conscious (i.e., set a DBE contract goal) and race-neutral (i.e., does not set a DBE contract goal) means in the DBE program?
4. Could you please describe the DBE commitments and attainments approaches?
5. What has been working well in the DBE program?
6. What are future improvements (challenges you encountered) in the DBE program?
7. Do you have a Business Development Program? If so, would you please describe how the program works?

DBE Supportive Services Program (15-20 Minutes)

1. What supportive services do you provide to DBEs in your state? (Common and Unique?)
    a. Business Plan, Networking, Financial, Short-term Loan, Training, Technical, Bonding, Labor, Management, Certification?
    b. Others: Mentor-Protégé program
2. How would you (what modes would you use to) provide these supportive services?
    a. Emails? Newsletter? Workshop? Webinar? Course? Conference?
    b. Partnership?
3. What supportive services have been working well in the past?
4. What are possible future improvements (challenges you encountered) in the SS program?

[End recording]

Closure

1. What are the research needs about the DBE and its programs?
2. Is there anything else that you would like to offer that I did not specifically ask about?

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APPENDIX F. INTERVIEW PROTOCOL FOR BECO FRAMEWORK

Hongtao Dang Comprehensive and Effective Supportive Services Semi-Structured Interview Protocol 2019

Pseudonym: _____ Informed Consent Form _____ (Check for completion)

Introduction

A review of survey results and BECO framework (page 2)

[Start recording]

Supportive Services (used and needed)

Q1. Would you please describe your experience with the DBE supportive services program? What services you have used and How beneficial?

Q2. Please describe your experience of the most beneficial supportive service. Why and how it benefit you or your business.

Q3. Please describe your experience of the least beneficial supportive services. Why and how it can be improved.

Q4. Would you please describe what supportive services you need and want to use but have not been able to get.

Q5. Have your needs of supportive services changed over time or as your business develop? If so, what are your previous, current, and future needs?

Q6. Would you please comment on your rating of various supportive services in the BECO framework? (Open discussion)

Adult Learning

Q1. Please describe your previous learning experience from DBE supportive services.

Q2. If you could go back, what would you change about the teaching from the teacher and the learning from yourself?

Q3. How many hours a week would you want to dedicate to learning of your interests?

Q4. How would you describe your ideal learning environment and experience?

[End recording]

Closure

1. Is there anything else you think we should talk about, but we have not discussed yet?

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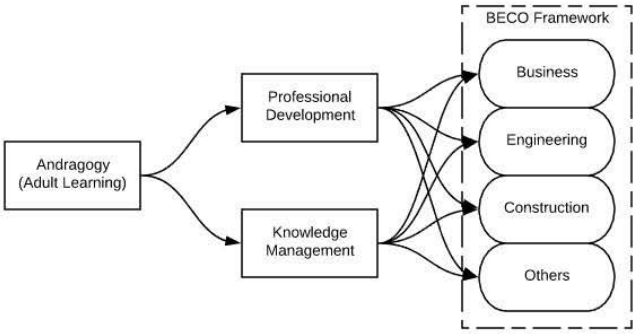

Figure 1 Conceptual Map of the BECO framework

Table 1 Various Key Topics in the BECO framework

Business	Engineering
• Marketing • Financial • Accounting • Operation and Management • Strategic Development • Administration • Human Resource • Investment	• Professional Licenses and Certifications • Insurance • Analysis • Design • Temporary Support • Software and Technology • Continuing Education • Sustainability
Construction	**Others**
• Bidding • Bonding • Safety • Project Scheduling and Cost Control • Law, Policy, and Regulation • Dispute Resolution • Contract Administration • Project Delivery Methods • Quality Assurance and Control • Jobsite Management • Trucking • Special Topics	• DBE Program Support • Business Development Program • Mentor-Protégé Program • Apprenticeship Program • Targeted Assistance Program • Local Assistance Program • Annual Conference • One-on-one assistance • Tuition Reimbursement • Miscellaneous • Collaboration with other organizations

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If you disagree with the researcher about the BECO framework discussed during the research interview, please sketch your own framework for providing comprehensive and effective supportive services. Please scan and send your sketch to hitdang@iastate.edu. Thank you!

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Business

- Marketing
  - Business card
  - Website development
  - Market analysis
  - Capabilities statement
- Financial
  - Access to Capital (Loans)
  - Bonding assistance
  - Balance sheet
  - Income statement
  - Cash flow
- Accounting
  - Payroll (QuickBooks)
  - Tax planning and returns
- Professional Skills
  - Communication
  - Teamwork & interpersonal
  - Leadership & ethic
  - Flexibility & Adaptability
- Operation and Management
  - Labor, material, and equipment
  - Supply chain, mobilization
  - Subcontractors
  - Client satisfaction
- Strategic Development
  - Vision, mission, and planning
  - Business plan
  - SWOT & P.E.S.T.
  - Porter's five-force
- Administration
  - Organizational structure
- Human Resource (Workforce)
  - Hiring new employees
  - Retaining existing employees
  - Workforce development
- Investment
  - Property, Plant, and Equipment (PP&E)

Engineering

- Professional license and certifications
  - Certified Professional Constructor (CPC)
  - Professional Engineer (PE)
  - Professional Surveyor (PS)
  - SE, LEED AP, CCM, PMP, others
- Insurance
  - Company, office, vehicle, equipment
- Analysis
  - Traffic
  - Environmental
  - Structural
- Design by infrastructure types
  - Buildings
  - Bridges
  - Roadways
- Design by materials
  - Steel
  - Concrete
  - Masonry
  - Wood
- Temporary Support
  - False work, cofferdam
- Software and Technology
  - AutoCAD, Revit, GIS
  - Virtual Design and Construction
  - Digital document management
- Continuing Education
  - Professional Development Hour (PDH) or Learning Unit (LU)
  - Continuing Education Unit (CEU)
- Sustainability
  - LEED, EVN SP
- Technical
  - Problem solving
  - Analytical skills
  - Critical thinking

Construction

- Bidding
  - Plan and specification reading
  - Cost Estimating
  - Bid preparation (proposal)
  - Mock bidding (bid express, bidx)
  - Statement of qualification
- Bonding
  - Financial statement preparation
- Safety
  - OSHA training
- Project Scheduling and Cost Control
  - Critical Path Method
  - Burn rate
- Contract Administration
  - Record keeping
  - Contract compliance
- Quality Assurance and Control
  - Quality management
  - Quality improvement
- Jobsite Management
  - On-jobsite-training
  - Labor, material, and equipment
  - Erosion control (e.g., storm water)
  - Traffic control (Flagging)
  - Material and product testing
  - Field inspection
- Special Topics
  - Project Delivery Methods
  - Civil integrated management
  - Preconstruction services
  - Design of construction systems
  - Equipment package optimization
  - Civil infrastructure systems
  - Law, policy, and regulation
  - Dispute resolution
  - Trucking registrations and licenses

Others

- DBE Program Support
  - Outreach and networking
  - Emails and newsletters
  - Certification requirements
  - DBE program introduction
  - Financial assistance (loans)
  - Unbundle large contracts
  - Goal setting
  - Release of retainage
  - Disparity and availability study
  - Incentive for DBE usage
  - Good faith effort
  - Self-performed work
  - Commercially useful function
  - Prompt pay provision
  - Contract compliance
  - Termination of non-performing DBE
  - Alternative contracting methods
- Relevant Programs
  - Business Development Program
  - Mentor-Protégé Program
  - Apprenticeship Program
  - Targeted Assistance Program
  - Local Assistance Program
- Annual Conference
- One-on-one assistance
  - Business review
  - Technical assistance
- Tuition Reimbursement
  - Training fees
  - Conference or Courses
- Miscellaneous
  - Technology
  - Entrepreneur
- Collaboration with other organizations
  - AGC, SBA, ASCE, PTAC
  - Economic Development Centers

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APPENDIX G. SUPPLEMENTARY SURVEY DATA FROM DBES

Education Background of Each Disadvantaged Group from DBE Survey Respondents.

Education Background	White Women	Black	Hispanic	Asian-Pacific	Subcontinent Asian	Native	Other	Total
Associate degree	23	23	9	5	2	1	2	65
Attended college but did not finish	37	48	32	8	0	4	7	136
Attended high school but did not finish	5	2	2	0	0	0	1	10
Bachelor's degree	165	110	51	31	11	9	6	383
Doctorate degree	24	31	5	7	2	1	3	73
High school diploma	18	12	15	2	1	0	2	50
Master's degree	172	117	52	27	34	5	13	420
Other	9	6	6	1	0	1	2	25
Vocational or technical degree	12	13	4	1	0	4	4	38
Total	465	362	176	82	50	25	40	1,200

Indication of Ready, Willing, and Able DBEs in Each Disadvantaged Group from DBE Survey Respondents

Ready, Willing, and Able	White Women	Black	Hispanic	Asian-Pacific	Subcontinent Asian	Native	Other	Total
Total Responses	468	363	177	84	50	25	40	1,207
Able	341	190	98	53	32	16	23	753
Ready	349	234	115	64	35	23	27	847
Willing	342	212	105	57	33	19	26	794

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Business Areas of DBEs in Each Disadvantaged Group from DBE Survey Respondents

Business Area	White Women	Black	Hispanic	Asian-Pacific	Subcontinent Asian	Native	Other	Total
Construction contracting	87	62	51	21	6	10	10	247
Engineering consulting	105	35	34	29	16	1	9	229
Local trucking	12	18	11	2	2	4	0	49
Others	219	152	46	22	16	9	14	478
Total	423	267	142	74	40	24	33	1,003

DBE Participation in DOT-assisted Contracts from DBE Survey Respondents (Questions 15, 15a, and 15b)

DBE Participation	White Women	Black	Hispanic	Asian-Pacific	Subcontinent Asian	Native	Other	Total
No	181	170	77	32	21	14	20	515
Yes	243	104	66	42	20	10	12	497
As a prime contractor per year								
1 to 3 times	67	37	21	10	6	4	4	149
12 or more times	14	1	3	0	2	0	0	20
4 to 7 times	12	1	3	6	4	0	0	26
8 to 11 times	2	1	0	3	0	0	0	6
None	146	63	38	23	8	6	8	292
As a subcontractor per year								
0 to 10 times	195	91	44	31	16	7	9	393
11 to 20 times	23	6	9	6	4	1	3	52
21 to 30 times	10	1	3	3	0	0	0	17
31 or more times	13	5	9	2	0	2	0	31

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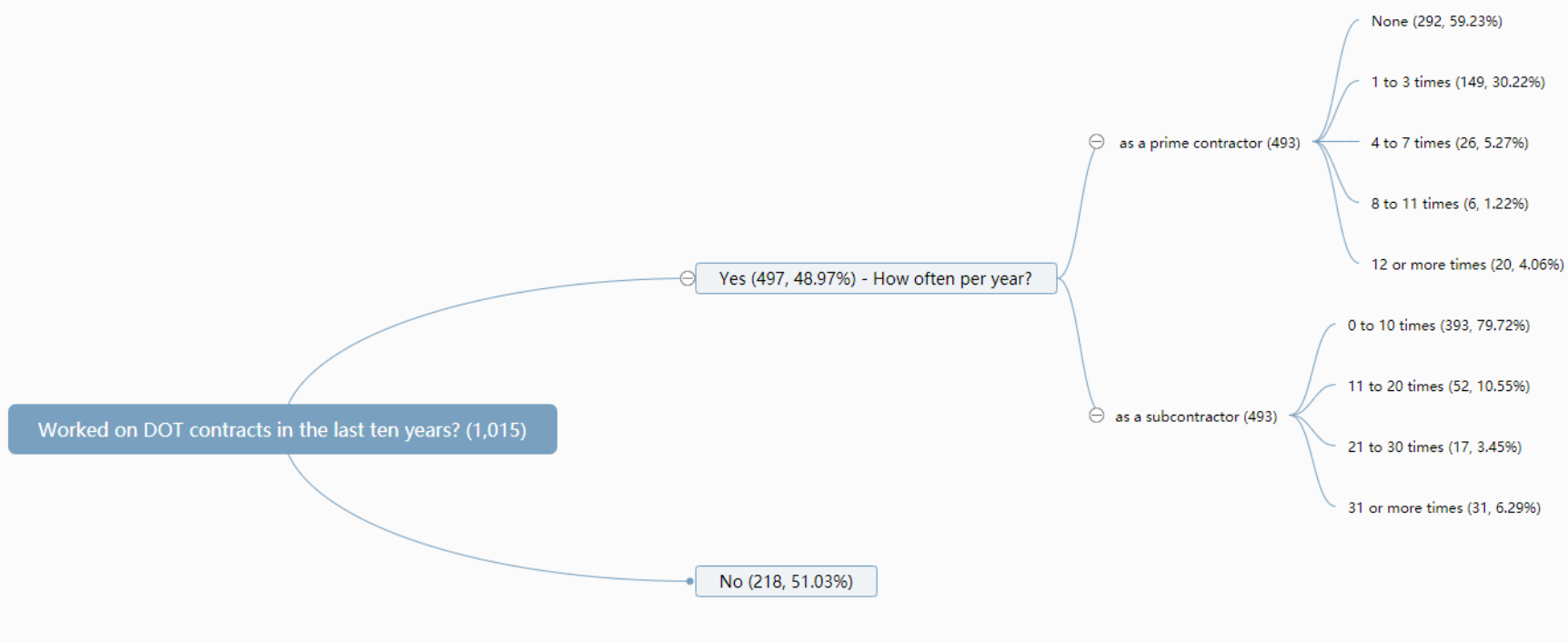
Mind Map for DBE Participation in DOT-assisted Contracts from DBE Survey Respondents (Questions 15, 15a, and 15b)



The Rating of Success of from DBE Survey Respondents

Rating for Success	White Women	Black	Hispanic	Asian-Pacific	Subcontinent Asian	Native	Other	Total
Extremely successful	46	10	9	3	1	1	2	72
Moderately successful	152	112	57	31	24	13	15	404
Not at all successful	7	20	6	5	2	0	0	40
Slightly successful	48	84	20	15	4	6	5	182
Very successful	170	43	50	18	10	4	11	306

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The Rating of Maturity of from DBE Survey Respondents

Rating for Maturity	White Women	Black	Hispanic	Asian-Pacific	Subcontinent Asian	Native	Other	Total
Extremely successful	151	98	44	28	18	10	11	360
Moderately successful	41	20	22	2	0	2	3	90
Not at all successful	20	25	8	3	4	0	0	60
Slightly successful	145	63	43	27	16	6	14	314
Very successful	64	61	25	12	3	6	5	176

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The Rating of Business Challenges for DBEs in Construction, Engineering, Local Trucking, and Others

Construction					
	Not Applicable	No challenge	Minor challenge	Somewhat challenge	Major challenge
BC_1	2	54	57	4	7
BC_2	14	57	39	8	5
BC_3	9	67	40	6	1
BC_4	9	40	54	9	12
BC_5	18	39	50	5	12
BC_6	4	51	55	6	8
BC_7	13	68	38	3	2
BC_8	6	84	31	2	1
BC_9	3	17	71	15	17
BC_10	21	67	31	2	3
BC_11	6	47	54	9	8
BC_12	9	69	36	8	2
BC_13	6	64	43	8	3
BC_14	3	25	73	10	13
BC_15	7	29	65	12	11
BC_16	2	72	40	6	3
BC_17	15	6	6	0	3

Engineering					
	Not Applicable	No challenge	Minor challenge	Somewhat challenge	Major challenge
BC_1	4	39	64	17	4
BC_2	10	52	50	10	4
BC_3	1	50	58	16	2
BC_4	27	40	41	9	10
BC_5	96	13	11	1	4
BC_6	5	48	58	7	10
BC_7	29	65	27	5	1
BC_8	33	50	38	4	3
BC_9	15	22	71	9	11
BC_10	43	57	21	2	2
BC_11	16	44	52	9	5
BC_12	17	67	34	4	4
BC_13	13	58	40	11	4
BC_14	19	31	53	12	11
BC_15	45	30	38	5	7
BC_16	4	57	51	13	0
BC_17	17	2	13	1	9

Local Trucking					
	Not Applicable	No challenge	Minor challenge	Somewhat challenge	Major challenge
BC_1	1	6	9	7	2
BC_2	6	9	9	0	0
BC_3	2	6	16	0	1
BC_4	3	4	13	2	3
BC_5	8	6	7	2	2
BC_6	2	10	10	1	2
BC_7	5	6	10	3	1
BC_8	3	6	11	3	2
BC_9	2	0	13	6	4
BC_10	9	8	7	1	0
BC_11	4	7	11	2	1
BC_12	6	11	7	1	0
BC_13	1	6	13	2	2
BC_14	1	8	5	7	3
BC_15	6	5	9	3	1
BC_16	1	10	11	1	1
BC_17	9	1	2	0	1

Others					
	Not Applicable	No challenge	Minor challenge	Somewhat challenge	Major challenge
BC_1	9	60	79	23	15
BC_2	21	73	71	13	6
BC_3	4	70	91	15	6
BC_4	52	44	66	12	12
BC_5	128	29	18	7	4
BC_6	10	78	72	19	6
BC_7	41	92	43	10	1
BC_8	28	75	59	21	2
BC_9	45	36	84	12	8
BC_10	70	84	25	6	1
BC_11	24	63	76	14	7
BC_12	39	91	40	9	7
BC_13	26	84	60	13	3
BC_14	16	55	77	16	23
BC_15	52	49	65	7	10
BC_16	11	93	62	15	3
BC_17	23	9	14	2	3

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The Rating of Overall Statement for DBEs in Construction, Engineering, Local Trucking, and Others (OS_4 and OS_5 are reversed from original rating)

Construction					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
OS_1	7	10	34	51	20
OS_2	9	18	18	53	25
OS_3	2	1	25	54	41
OS_4	1	13	31	54	24
OS_5	3	11	27	51	31
OS_6	1	26	12	31	53
OS_7	3	27	26	30	37
OS_8	11	20	33	26	32
OS_9	7	21	26	32	37
OS_10	5	28	42	26	22
OS_11	7	29	32	42	13
OS_12	15	34	32	33	9
OS_13	9	21	49	32	12
OS_14	7	14	38	45	18
OS_15	8	12	49	36	17

Engineering					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
OS_1	0	8	25	57	33
OS_2	2	17	19	58	28
OS_3	0	5	18	54	48
OS_4	4	16	38	40	26
OS_5	1	19	31	42	31
OS_6	6	14	11	44	50
OS_7	1	16	26	41	40
OS_8	3	15	38	42	26
OS_9	0	12	34	35	41
OS_10	2	22	30	35	34
OS_11	4	28	41	42	8
OS_12	9	43	32	33	7
OS_13	6	24	48	38	7
OS_14	5	14	44	53	9
OS_15	0	16	45	46	18

Local Trucking					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
OS_1	2	0	7	9	6
OS_2	1	3	6	9	4
OS_3	0	0	1	15	7
OS_4	1	0	12	6	4
OS_5	1	0	12	6	4
OS_6	1	1	3	10	8
OS_7	2	1	5	4	11
OS_8	3	2	8	5	5
OS_9	2	0	4	7	10
OS_10	2	0	8	5	8
OS_11	0	4	11	7	1
OS_12	3	5	10	5	0
OS_13	0	5	10	8	0
OS_14	0	4	9	9	1
OS_15	1	3	10	8	1

Others					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
OS_1	7	17	33	81	41
OS_2	11	30	26	89	24
OS_3	3	4	17	86	69
OS_4	2	21	45	64	45
OS_5	3	21	42	65	49
OS_6	13	17	24	54	71
OS_7	9	23	43	44	61
OS_8	9	30	59	48	33
OS_9	4	20	29	62	62
OS_10	4	23	48	58	47
OS_11	24	37	64	40	13
OS_12	24	56	55	35	9
OS_13	17	43	55	53	11
OS_14	15	29	43	70	19
OS_15	13	20	76	49	20

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APPENDIX H. SURVEY RESPONSES FOR SUPPORTIVE SERVICES

Q23 – Please indicate the usefulness of the following business-related supportive services.

#	Field	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful	Total
1	Overall supportive services in marketing	16.56% 50	12.91% 39	19.87% 60	22.19% 67	23.18% 70	5.30% 16	302
2	Business cards	17.93% 59	17.33% 57	20.36% 67	18.54% 61	19.15% 63	6.69% 22	329
3	Website development	18.18% 60	10.00% 33	12.12% 40	22.73% 75	26.67% 88	10.30% 34	330
4	Market analysis	20.18% 66	11.01% 36	18.96% 62	22.32% 73	21.10% 69	6.42% 21	327
5	Capabilities statement	15.20% 50	8.51% 28	18.54% 61	20.97% 69	26.44% 87	10.33% 34	329
6	Overall supportive services in financial	22.15% 68	6.84% 21	16.29% 50	18.57% 57	22.80% 70	13.36% 41	307
7	Access to capital (loans or credits)	22.89% 76	10.54% 35	15.06% 50	13.25% 44	25.90% 86	12.35% 41	332
8	Bonding assistance	54.17% 182	8.93% 30	8.33% 28	8.04% 27	12.80% 43	7.74% 26	336
9	Balance sheets	21.36% 72	13.65% 46	16.91% 57	21.66% 73	20.47% 69	5.93% 20	337
10	Income statements	20.18% 68	13.65% 46	14.84% 50	22.26% 75	22.85% 77	6.23% 21	337
11	Cash flow management	22.26% 75	12.17% 41	15.13% 51	17.21% 58	23.44% 79	9.79% 33	337
12	Overall supportive services in accounting	22.41% 67	11.04% 33	13.38% 40	15.72% 47	23.75% 71	13.71% 41	299
13	Payroll (QuickBooks)	25.00% 84	10.42% 35	11.61% 39	15.18% 51	24.40% 82	13.39% 45	336
14	Tax planning and returns	24.32% 81	10.81% 36	10.51% 35	17.12% 57	22.22% 74	15.02% 50	333
15	Overall supportive services in professional skills	17.36% 54	9.97% 31	18.01% 56	20.90% 65	23.79% 74	9.97% 31	311
16	Communication	12.99% 43	9.37% 31	20.54% 68	20.24% 67	25.98% 86	10.88% 36	331
17	Teamwork & interpersonal skills	17.42% 58	9.61% 32	19.22% 64	20.42% 68	22.52% 75	10.81% 36	333
18	Leadership & work ethic	17.22% 57	10.27% 34	19.03% 63	18.73% 62	20.85% 69	13.90% 46	331
19	Flexibility & adaptability	17.27% 57	10.91% 36	21.21% 70	17.27% 57	21.52% 71	11.82% 39	330
20	Overall supportive services in operation and management	17.10% 53	9.35% 29	19.03% 59	22.58% 70	20.32% 63	11.61% 36	310

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#	Field	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful	Total
21	Developing vision and mission	16.97% 56	12.73% 42	19.39% 64	19.70% 65	20.91% 69	10.30% 34	330
22	Preparing a business plan	18.24% 60	12.16% 40	19.15% 63	20.97% 69	20.36% 67	9.12% 30	329
23	Business analysis tools (SWOT, PEST)	27.61% 90	12.58% 41	19.02% 62	17.18% 56	16.56% 54	7.06% 23	326
24	(Sub)Contractors/consultants management	24.62% 81	11.85% 39	19.15% 63	16.41% 54	19.76% 65	8.21% 27	329
25	Supply chain and mobilization	40.98% 134	13.46% 44	13.76% 45	14.07% 46	13.46% 44	4.28% 14	327
26	Overall supportive services in administration	22.71% 72	10.73% 34	20.19% 64	22.08% 70	17.03% 54	7.26% 23	317
27	Organizational structure	22.94% 75	13.46% 44	20.80% 68	19.88% 65	17.43% 57	5.50% 18	327
28	Overall supportive services in human resources	25.23% 82	12.00% 39	19.08% 62	20.62% 67	17.85% 58	5.23% 17	325
29	Hiring new employees	27.49% 91	13.60% 45	16.92% 56	15.11% 50	19.64% 65	7.25% 24	331
30	Retaining existing employees	27.79% 92	12.69% 42	16.31% 54	15.11% 50	20.85% 69	7.25% 24	331
31	Workforce development	25.30% 84	10.84% 36	19.88% 66	15.36% 51	21.39% 71	7.23% 24	332
32	Overall Supportive Services in investment	31.66% 101	14.11% 45	16.30% 52	16.30% 52	16.93% 54	4.70% 15	319
33	Property, Plant, and Equipment (PP&E)	45.45% 150	12.73% 42	14.24% 47	13.33% 44	10.00% 33	4.24% 14	330
34	Other	72.84% 59	2.47% 2	2.47% 2	4.94% 4	9.88% 8	7.41% 6	81

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Q24 – Please indicate the usefulness of the following engineering-related supportive services

#	Field	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful	Total
1	Overall supportive services in getting professional licenses and certifications	43.65% 134	11.07% 34	13.36% 41	9.45% 29	14.33% 44	8.14% 25	307
2	Certified Professional Constructor (CPC)	71.24% 213	7.69% 23	7.69% 23	5.69% 17	4.68% 14	3.01% 9	299
3	Professional Engineer (PE)	62.33% 187	9.00% 27	8.00% 24	5.67% 17	7.67% 23	7.33% 22	300
4	Professional Surveyor (PS)	73.00% 219	8.33% 25	5.67% 17	4.67% 14	4.67% 14	3.67% 11	300
5	Overall supportive services in insurance	42.61% 124	11.00% 32	12.03% 35	12.37% 36	13.06% 38	8.93% 26	291
6	Company and office space	41.33% 124	13.00% 39	16.00% 48	12.67% 38	11.33% 34	5.67% 17	300
7	Vehicle and equipment	46.67% 140	11.00% 33	15.67% 47	12.67% 38	7.00% 21	7.00% 21	300
8	Overall supportive service in technical analysis	53.22% 157	9.83% 29	9.15% 27	11.86% 35	10.85% 32	5.08% 15	295
9	Traffic analysis	66.11% 197	9.73% 29	5.37% 16	7.38% 22	8.39% 25	3.02% 9	298
10	Environmental analysis	59.66% 176	8.47% 25	9.15% 27	8.14% 24	8.47% 25	6.10% 18	295
11	Structural analysis	67.11% 200	8.72% 26	6.71% 20	7.72% 23	5.70% 17	4.03% 12	298
12	Overall supportive services in design by infrastructure type	65.17% 189	8.28% 24	7.93% 23	6.90% 20	6.55% 19	5.17% 15	290
13	Buildings	68.79% 205	8.39% 25	6.38% 19	7.05% 21	5.70% 17	3.69% 11	298
14	Bridges	67.23% 199	7.77% 23	7.09% 21	7.09% 21	7.43% 22	3.38% 10	296

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#	Field	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful	Total
15	Roads	57.97% 171	9.15% 27	6.78% 20	11.19% 33	8.47% 25	6.44% 19	295
16	Overall supportive services in design by material type	67.80% 200	7.46% 22	7.46% 22	6.78% 20	5.76% 17	4.75% 14	295
17	Steel	69.31% 201	7.93% 23	6.21% 18	7.59% 22	5.17% 15	3.79% 11	290
18	Concrete	67.13% 194	6.57% 19	6.57% 19	8.30% 24	6.57% 19	4.84% 14	289
19	Masonry	70.34% 204	8.28% 24	7.59% 22	5.52% 16	4.83% 14	3.45% 10	290
20	Wood	71.03% 206	8.28% 24	6.21% 18	5.52% 16	5.52% 16	3.45% 10	290
21	Overall supportive services in temporary supports	71.88% 207	7.29% 21	4.51% 13	7.29% 21	4.51% 13	4.51% 13	288
22	False support	80.55% 236	7.85% 23	4.78% 14	2.73% 8	2.39% 7	1.71% 5	293
23	Cofferdam	77.47% 227	7.85% 23	6.14% 18	4.10% 12	2.73% 8	1.71% 5	293
24	Overall supportive services in software and technology	50.51% 149	8.14% 24	10.17% 30	10.85% 32	11.53% 34	8.81% 26	295
25	AutoCAD, Revit, or GIS	50.00% 148	7.77% 23	7.77% 23	11.82% 35	14.19% 42	8.45% 25	296
26	Virtual design and construction	58.84% 173	7.82% 23	8.16% 24	7.82% 23	10.88% 32	6.46% 19	294
27	Digital document management systems	50.17% 146	7.22% 21	9.28% 27	10.31% 30	14.43% 42	8.59% 25	291
28	Overall supportive services in continuing education	42.86% 129	5.98% 18	11.96% 36	13.62% 41	13.95% 42	11.63% 35	301
29	Professional Development Hour (PDH)	45.45% 135	6.06% 18	14.81% 44	12.79% 38	12.79% 38	8.08% 24	297
30	Overall supportive services in sustainability	48.81% 144	9.83% 29	13.22% 39	8.47% 25	10.51% 31	9.15% 27	295
31	Leadership in Energy and Environmental Design (LEED)	53.40% 157	7.48% 22	13.61% 40	7.82% 23	9.86% 29	7.82% 23	294
32	Overall supportive services in other technical skills	43.00% 126	8.53% 25	13.65% 40	12.97% 38	12.29% 36	9.56% 28	293
33	Problem solving	35.81% 106	8.45% 25	15.88% 47	14.19% 42	14.53% 43	11.15% 33	296
34	Analytical skills	37.29% 110	8.81% 26	16.27% 48	12.20% 36	14.24% 42	11.19% 33	295
35	Critical thinking	35.93% 106	9.49% 28	15.25% 45	12.54% 37	14.58% 43	12.20% 36	295

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Q25 – Please indicate the usefulness of the following construction-related supportive services

#	Field	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful	Total
1	Overall supportive services in bidding assistance	43.55% 125	7.67% 22	11.85% 34	12.54% 36	10.80% 31	13.59% 39	287
2	Plan and specification reading	41.97% 115	9.85% 27	9.12% 25	12.04% 33	14.96% 41	12.04% 33	274
3	Quantity and cost estimating	42.91% 118	7.64% 21	8.00% 22	13.09% 36	15.64% 43	12.73% 35	275
4	Proposal (bid, price, and qualification) preparation	37.45% 103	8.00% 22	11.27% 31	12.36% 34	15.27% 42	15.64% 43	275
5	Mock bidding interviews	48.91% 134	10.95% 30	10.22% 28	8.39% 23	12.04% 33	9.49% 26	274
6	Overall supportive services in bonding assistance	58.45% 166	6.69% 19	8.10% 23	8.10% 23	8.10% 23	10.56% 30	284
7	Financial statement preparation	44.93% 124	8.70% 24	9.78% 27	12.32% 34	12.68% 35	11.59% 32	276

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#	Field	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful	Total
8	Overall supportive services in safety	45.77% 130	5.63% 16	9.51% 27	13.03% 37	13.73% 39	12.32% 35	284
9	OSHA training	43.32% 120	5.42% 15	12.27% 34	13.36% 37	15.16% 42	10.47% 29	277
10	Overall supportive services in project scheduling and cost control	44.29% 124	8.57% 24	11.79% 33	8.57% 24	17.50% 49	9.29% 26	280
11	Critical Path Method	46.91% 129	8.36% 23	12.36% 34	8.00% 22	16.00% 44	8.36% 23	275
12	Burn rate	55.11% 151	7.66% 21	10.58% 29	7.66% 21	12.04% 33	6.93% 19	274
13	Overall supportive services in contract administration	40.65% 113	6.83% 19	14.75% 41	8.99% 25	19.06% 53	9.71% 27	278
14	Record keeping	35.38% 98	7.22% 20	14.08% 39	15.88% 44	15.52% 43	11.91% 33	277
15	Contract compliance	30.25% 85	6.41% 18	15.30% 43	14.59% 41	19.57% 55	13.88% 39	281
16	Overall supportive services in quality control and assurance	36.40% 103	8.83% 25	14.49% 41	10.60% 30	16.25% 46	13.43% 38	283
17	Quality management	36.13% 99	8.76% 24	14.60% 40	12.04% 33	15.33% 42	13.14% 36	274
18	Quality improvement	36.59% 101	8.33% 23	14.86% 41	10.87% 30	16.67% 46	12.68% 35	276
19	Overall supportive services in job site management	46.98% 132	7.47% 21	12.81% 36	8.54% 24	14.23% 40	9.96% 28	281
20	On-job-site training	47.23% 128	9.23% 25	11.07% 30	11.07% 30	11.07% 30	10.33% 28	271
21	Labor, material, and equipment	50.91% 140	8.73% 24	10.18% 28	8.36% 23	12.00% 33	9.82% 27	275
22	Storm water (SWPPP)	61.59% 170	5.43% 15	7.97% 22	7.61% 21	8.33% 23	9.06% 25	276
23	Traffic control (flagging)	64.36% 177	5.45% 15	7.64% 21	6.91% 19	9.82% 27	5.82% 16	275
24	Material and product testing	63.64% 175	4.36% 12	9.82% 27	6.18% 17	9.09% 25	6.91% 19	275
25	Field inspection	55.64% 153	5.45% 15	11.27% 31	7.64% 21	10.55% 29	9.45% 26	275
26	Overall supportive services in special topics	57.09% 157	6.18% 17	10.18% 28	7.27% 20	9.09% 25	10.18% 28	275
27	Project delivery methods	53.51% 145	5.54% 15	10.33% 28	10.33% 28	11.07% 30	9.23% 25	271
28	Pre-construction services	52.40% 142	5.54% 15	11.07% 30	9.23% 25	12.18% 33	9.59% 26	271
29	Equipment package optimization	67.77% 185	6.96% 19	5.86% 16	6.23% 17	6.96% 19	6.23% 17	273
30	Law, policy, and regulation	48.16% 131	4.78% 13	11.40% 31	11.40% 31	12.50% 34	11.76% 32	272
31	Dispute resolution	45.96% 125	5.51% 15	12.87% 35	12.13% 33	12.50% 34	11.03% 30	272

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Q26 – Please indicate the usefulness of the following other supportive services

#	Field	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful	Total
1	Overall supportive services about the DBE program	10.31% 27	5.73% 15	20.99% 55	24.05% 63	23.66% 62	15.27% 40	262
2	Outreach and networking	10.36% 29	6.07% 17	21.43% 60	22.14% 62	22.86% 64	17.14% 48	280
3	Email-blasts and newsletters	8.87% 25	13.83% 39	27.30% 77	23.05% 65	14.54% 41	12.41% 35	282
4	Certification requirements	10.11% 28	9.75% 27	19.49% 54	20.58% 57	25.99% 72	14.08% 39	277
5	DBE program introduction/orientation	12.86% 36	8.21% 23	23.93% 67	16.79% 47	24.29% 68	13.93% 39	280
6	Financial assistance (loans)	30.82% 86	11.11% 31	13.98% 39	15.41% 43	13.98% 39	14.70% 41	279
7	Unbundling large contracts	28.06% 78	9.71% 27	12.59% 35	13.31% 37	14.75% 41	21.58% 60	278
8	Prompt pay provision	17.73% 50	8.16% 23	12.06% 34	8.51% 24	21.28% 60	32.27% 91	282
9	Release of retainage	30.69% 85	6.86% 19	10.11% 28	7.94% 22	18.77% 52	25.63% 71	277
10	Overall supportive services about relevant programs	22.44% 57	5.91% 15	21.65% 55	13.78% 35	17.72% 45	18.50% 47	254
11	Business development program	22.34% 61	5.49% 15	20.15% 55	17.95% 49	16.85% 46	17.22% 47	273
12	Mentor-protege program	24.64% 68	11.23% 31	20.29% 56	13.04% 36	14.49% 40	16.30% 45	276

#	Field	Not Applicable (N.A.)	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful	Total
13	Apprenticeship program	35.87% 99	12.32% 34	15.58% 43	10.87% 30	13.77% 38	11.59% 32	276
14	Targeted assistance program	32.48% 89	14.23% 39	15.69% 43	11.31% 31	13.50% 37	12.77% 35	274
15	Local assistance program	29.78% 81	9.56% 26	15.44% 42	16.91% 46	15.07% 41	13.24% 36	272
16	Annual conference	26.62% 74	8.63% 24	20.14% 56	20.50% 57	14.03% 39	10.07% 28	278
17	One-on-one assistance	21.45% 59	6.55% 18	14.55% 40	15.27% 42	22.91% 63	19.27% 53	275
18	Tuition reimbursement	40.43% 112	7.58% 21	10.11% 28	10.83% 30	17.33% 48	13.72% 38	277
19	Collaboration with other organizations (AGC, ASCE, SBA)	24.64% 68	6.88% 19	15.94% 44	16.67% 46	19.57% 54	16.30% 45	276

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