

# 7(j) Training Program for 8(a) Participants Evaluation Report

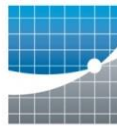
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Office of Program Performance, Analysis, and Evaluation  
409 3rd Street SW  
Washington, DC 20416



U.S. Small Business  
Administration

Prepared by:  
Optimal Solutions Group, LLC  
5825 University Research Court, Suite 2800  
College Park, MD 20740



OPTIMAL SOLUTIONS GROUP, LLC  
REAL-TIME DATA-DRIVEN DECISION MAKING

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The statements, findings, and conclusions found in this study are those of the contractor and do not necessarily reflect the views of the Office of Program Performance, Analysis, and Evaluation, the United States Small Business Administration, or the United States Government.

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## Glossary

Term	Definition
7(j)	A federal management and technical assistance program for 8(a) participants and other businesses owned socioeconomically disadvantaged individuals
8(a)	A federal procurement socioeconomic program for small businesses
BDMIS	Business Development Management Information System
BPA	Blanket Purchase Agreement
CEM	Coarsened Exact Matching
DUNS	Data Universal Numbering System
FPDS-NG	Federal Procurement Data System – Next Generation
FOUO	For Official Use Only
GSA	U.S. General Services Administration
HUBZone	Historically Underutilized Business Zone
MSA	Metropolitan Statistical Area
NAICS	North American Industry Classification System
OSDBU	Office of Small and Disadvantaged Business Utilization
OM&TA	Office of Management and Technical Assistance
PAM	Partition Around Medoids
RFP	Request for Proposal
SAM	System for Award Management
SATT	Sample Average Treatment Effect on the Treated
SBA	U.S. Small Business Administration
SBGR	Small Business Goaling Report
SVM	Support Vector Machines
VOSB	Veteran-Owned Small Business
WOSB	Women-Owned Small Business

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# Executive Summary

The 7(j) online training program is a resource provided by the Small Business Administration (SBA) to all 8(a) participants since Fiscal Year (FY) 2013. Through training and education, the program helps 8(a) businesses by enhancing their capacity to obtain federal contracts. To understand the impact of the 7(j) online training program, the SBA has requested a study to evaluate its performance by answering the following research questions:

1. What are 8(a) participants' pattern of attendance in 7(j) online trainings and why do they start, stop, or never attend the training?
2. What characteristics of 8(a) firms and 7(j) online trainings relate to obtaining a (first) federal contract?
3. To what extent is 7(j) online training related to meeting business activity (non-8(a) contract) targets?

The study could be used by 1) 8(a) businesses, to make more informed decisions about whether and which online courses to take to drive their business success; 2) 7(j) course designers and instructors to better understand which courses trainees find most useful and why; and 3) by SBA program managers to inform their decisions on programmatic resources.

**Key Findings:** The study found that from FY2014-FY2017, just under 10 percent of all 8(a) businesses enrolled in one or more 7(j) online training courses. Multiple people representing the same business may have taken different courses. Grouping the attendance of individuals at the business level, the average number of 7(j) online training courses by 8(a) businesses was four. Of the 19 courses offered, enrollment was highest in eight courses, which focused on marketing and contracting. The research found that 8(a) businesses that received 7(j) training had a 12 percentage point higher probability of receiving an initial federal contract than comparable 8(a) businesses that did not receive 7(j) training. This increases the likelihood of obtaining federal contracts for 8(a) businesses from 47 percent to 59 percent. The research also found that 8(a) business with 7(j) training obtain contracts on average within 511 days from the date of first training while those without training take on average 588 days. Therefore, businesses that took the training obtained their first contract 77 days faster than those businesses that did not take the training. While trainees had a higher probability than non-trainees of obtaining an initial federal contract, the study found no difference between the two groups in the probability of obtaining non-8(a) contracts, which are contracts not specifically set-aside for 8(a) businesses.

Characteristics of 8(a) businesses were a strong predictor of course selection by 7(j) training participants. Based on their first-year course taking pattern, 7(j) trainees who joined the 8(a) program in FY2014 could be classified into four groups. Courses taken by Group 1 focused on federal contracting and marketing courses and overwhelmingly (62 percent) operated businesses in the Professional, Scientific, and Technical sectors. Group 1 trainees also contained a large

share of both female-owned (38 percent) and veteran-owned businesses (38 percent). Group 2 concentrated on construction courses and primarily worked in either the Manufacturing or Construction sectors (83 percent). Group 2 did not contain any female-owned businesses. Group 3, the largest group, did not show any preference for any given subject and were clustered in the Professional, Scientific, and Technical sector (52 percent) and the Manufacturing and Construction sectors (28 percent). Group 3 trainees had the highest share of female-owned businesses (40 percent) and the largest number of employees (roughly 12 on average). Group 4 primarily enrolled in federal contracting courses. Businesses in Group 4 largely represented the Professional, Scientific, and Technical sector (57 percent) similar to Group 1 (62 percent), but Group 4 consisted of many businesses in the Manufacturing and Construction sectors (21 percent) while Group 1 had none.

# Introduction

**Research Objective:** The Management and Technical Assistance 7(j) Training Program (7(j) or the 7(j) program) is one of several resources that small businesses in the 8(a) Business Development Program (8(a) or the 8(a) program) can use to improve their chances of a successful bid on a federal contract opportunity. Specifically, 7(j) online training is a resource available to all 8(a) participants since FY2013 regardless of location. The SBA seeks evidence on the effectiveness of 7(j) online training, and how it can be maximized for 8(a) participants, or a subset of participants, or identify the most effective topics. The SBA has requested a study to evaluate the performance of the 7(j) online training program by answering the following research questions:

1. What are 8(a) participants' pattern of attendance in 7(j) online trainings and why do they start, stop, or never attend the training?
2. What characteristics of 8(a) firms and 7(j) online trainings relate to obtaining a (first) federal contract?
3. To what extent is 7(j) online training related to meeting business activity (non-8(a) contract) targets?

**Intended Audience:** 8(a) businesses have limited resources and time is a major constraint. 8(a) businesses cannot afford to invest time in training that does not produce tangible results. The success of 8(a) businesses as a result of 7(j) training has been anecdotal. The findings from this study will provide rigorous evidence of the effects of 7(j) online training on obtaining federal contracts. This evidence could be used by 8(a) businesses who could use the information to determine whether to take online courses.

The results will also be useful for 7(j) course designers and instructors. While the training course designers and implementers gather feedback from course participants after courses are complete, it tends to be a snapshot that measures satisfaction. The findings of this study will provide data on 8(a) businesses' course taking pattern and whether 7(j) training helps them obtain federal contracts.

Lastly, the findings will be helpful to SBA program managers to understand the overall effectiveness of the 7(j) online training program. These insights can not only inform the SBA's efforts to better promote the program, but also make changes to improve its performance.

**Summary of Findings:** The research team found that the characteristics of 8(a) businesses that elect to take 7(j) training vary from those businesses which do not. Select business characteristics, such as annual revenue, business age, and number of employees, can be used to predict which 8(a) businesses participate in 7(j) training with 70 percent accuracy. Similarly, 8(a) businesses can be grouped based on their courses taking pattern, where business within each

group vary by characteristics, most notably by their industry or sector. However, the study found that most businesses did not have a clear course taking pattern in their first year and first four years in the 8(a) program. The study found that participating in 7(j) training not only increases the likelihood of 8(a) businesses in obtaining federal contracts by 12 percentage points, but it also increases the rate at which they obtain the contract by 14 percent or approximately 77 days. Lastly, the study found no relationship between 7(j) online training and meeting business activity targets of obtaining non-8(a) contracts<sup>1</sup>.

***Outline of the Report:*** This report begins with a brief description of the 8(a) and 7(j) programs and a synopsis of the major themes identified in the literature review which informed the research design. The report then describes the data and research design, presents a detailed discussion of results, and outlines limitations. The report concludes by summarizing the key findings and presenting the study's recommendation to improve program performance.

## Overview of the Program

***8(a) Program:*** The federal government established the 8(a) program to improve the capacity of small businesses owned by the socially and economically disadvantaged members of society. To help provide a level playing field for small businesses owned by socially and economically disadvantaged people or entities, the government limits competition for certain contracts to businesses that participate in the 8(a) program. Businesses enrolled in the 8(a) program can:

1. Compete for set-aside and sole source contracts;
2. Receive support from a business opportunity specialist to aide them in navigating the federal contracting process;
3. Form partnerships with more established businesses through the SBA's mentor-protégé program; and
4. Receive management and technical assistance, including business training, counseling, marketing assistance, and high-level executive development.

The SBA uses the 8(a) program to increase the supply of businesses owned and operated by socially and economically disadvantaged entrepreneurs. The 8(a) program encourages these entrepreneurs to start and expand businesses by providing access to federal contracts through set-asides and sole source contract vehicles, business support through training, and management and technical assistance. Figure 1 below illustrates the mechanism of the 8(a) program through its logic model

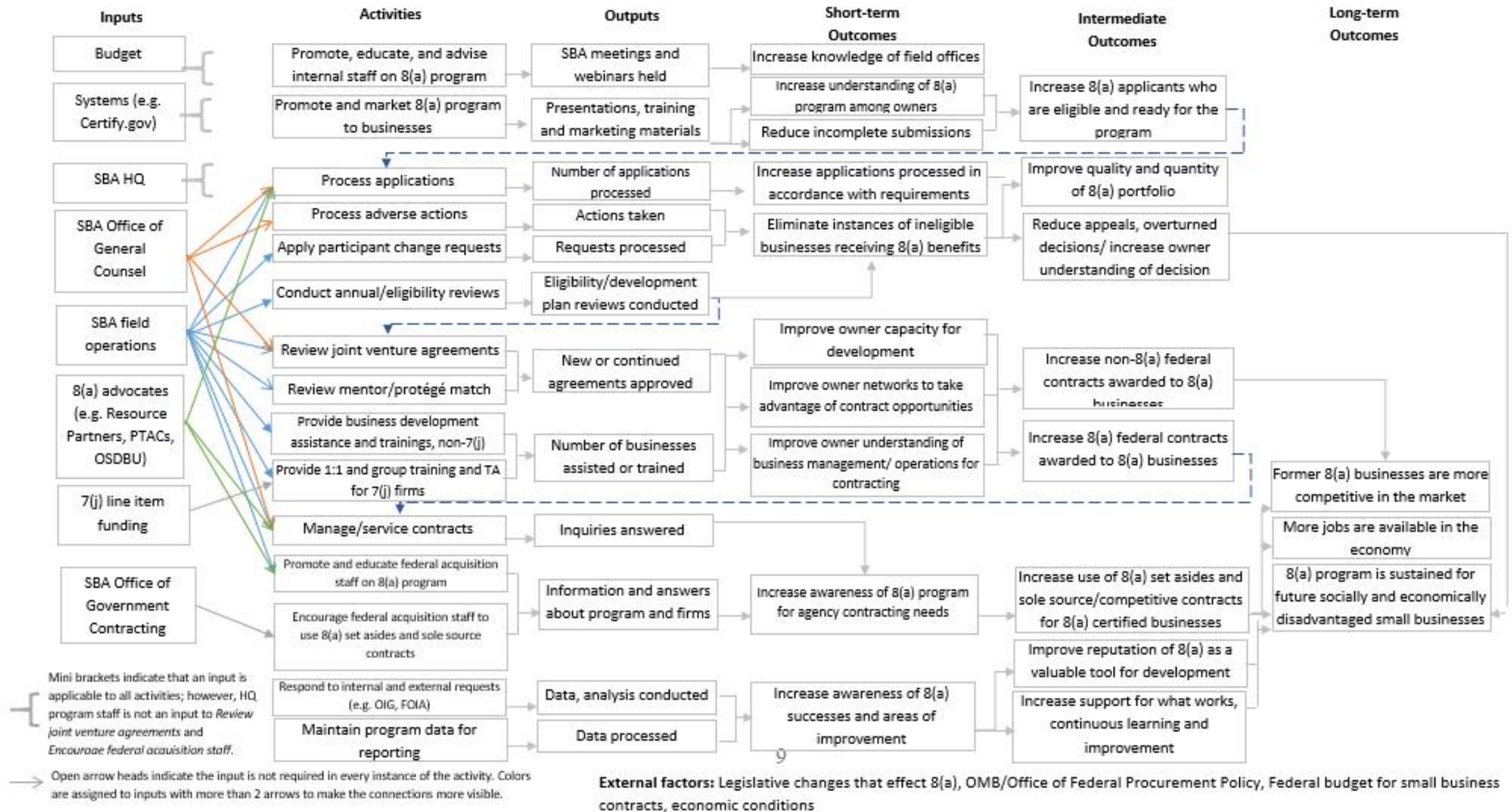
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<sup>1</sup> To ensure businesses in the 8(a) program are not overly reliant on 8(a) contract awards, participating business businesses are required to make substantial effort in obtaining non-8(a) contracts during years five through nine of the program. The non-8(a) business activity target outlines the minimum required non-8(a) revenue as a percent of the total revenue participating businesses must maintain. It starts at 15 percent of total revenue in year five and rises to 55 percent in year nine (13 CFR § 124.509, 1998, 2009, 2011).



**Figure 1: SBA 8(a) Business Development Program Logic Model**

Program Mission: Help socially and economically disadvantaged owners develop their business



**7(j) Program:** The 7(j) program provides training, executive education, and one-on-one consulting in a broad range of business disciplines, including federal contracting, to socially and economically disadvantaged businesses. While the 7(j) training program is offered by a number of vendors both in-person and online, this study only focused on the online training provided by Stover & Associates, Inc. (Stover). Therefore, any findings and discussions of this study are not representative of the overall 7(j) program but reflective of only the 7(j) online training program offered by Stover.

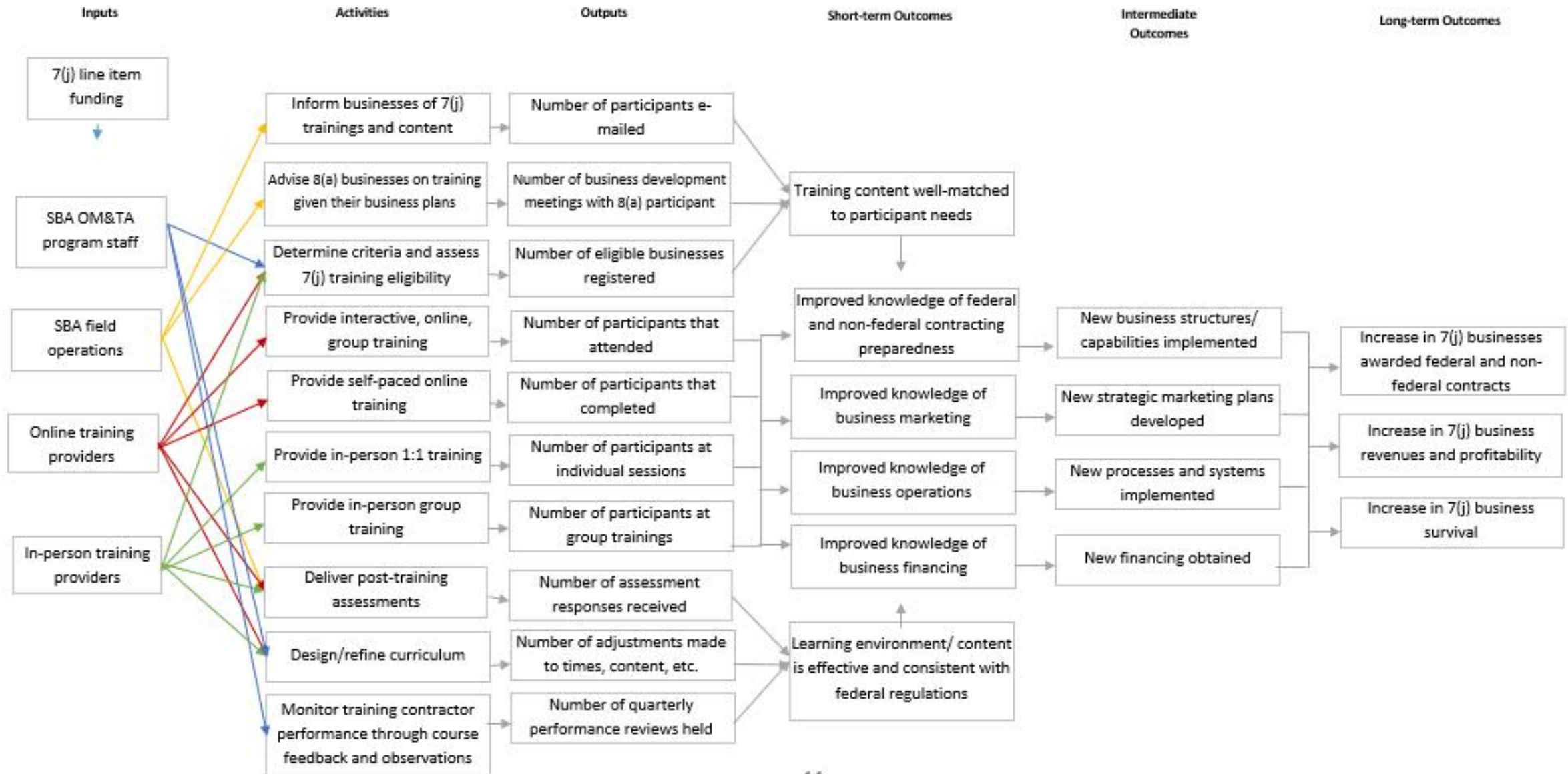
The 7(j) program is designed to be flexible and voluntary—8(a) businesses are not required to take any of the available training courses. While there are 19 online 7(j) training courses, the program does not require which courses to take, how many courses to take, or in what sequence to take them. With no required course curriculum, there is no a priori theory about the level of training that should be associated with business improvements. While the flexible program design is intended to facilitate business participation, training course designers and implementers and 8(a) businesses may find it challenging to identify which training could improve their outcomes.

The program's logic model, illustrated in Figure 2, shows that the program is built on the theory that eligible 8(a) businesses will select training courses from a range of available options based on their needs. Successfully completing the training course should help improve their business relevant knowledge and provide them with a greater understanding of federal contract opportunities. This new knowledge should lead to improved business operations. The improvement in business operations should make the business a more capable federal contractor. These improved operations should lead to increased federal and non-federal business opportunities. With the new business opportunities, 8(a) businesses that received the 7(j) training should increase revenue, profits, and survive longer.

While the program design does not contain a direct mechanism for linking training effectiveness to business outcomes, it does provide market feedback. If a business does not perceive increased value, it may not take additional courses. That is, an 8(a) business that participates in a course may only take a second or third course if it can connect the training to a tangible business outcome. Unfortunately, this type of market response evaluation, while useful, is prone to confirmation bias and overgeneralization based on limited anecdotal evidence.

**Figure 2: SBA 7(j) Management and Technical Assistance Program Logic Model**

Program Mission: Assist small business concerns owned by disadvantaged persons to become self-sufficient and viable.



# Literature Review

To inform the research design, the team conducted a literature review to better understand the relationship between online training and business outcomes. The research identified six overall themes.

***Quality of online courses:*** Literature on online training concludes that the quality of the training course is one of the most profound factors that impacts students' or participants' learning and outcomes. Sun, Tsai, Finger, Chen, and Yeh (2008) state that course quality is the single most important factor of online training. Course quality and technological design are major factors in students' satisfaction with a course. Clarity and consistency in course organization, goals, and instructor expectations lead to increased effectiveness of learning (Swan, 2003). Using the findings from the literature, the research team identified data on evaluating training instructors as proxy for training quality. Instructors were ranked on a scale of 1 to 5, with 1 being poor and 5 being excellent. The research team's review of 7(j) training data found little variation in instructor quality with an average rating of 3.5.

***Interactivity:*** The level of interaction between students and instructors is an important predictor of online course quality. Swan (2003) finds that training outcomes are improved the more interaction that participants have with course content, instructors, and other training peers. "The quantity and quality of instructor interactions with students is linked to student learning" (Swan, 2003). While no administrative or survey data captured interactivity during the trainings, the study explored this phenomenon by asking training instructors through interviews about the level of interaction participants had with instructors and among each other using the interactive chat feature of the webinar tool.

***Ease of access for participants with low computer-literacy:*** Literature suggests that computer literacy of the training participants closely connects to the outcomes of online training programs with higher computer literacy leading to higher learning performance (Lim, Lee, & Nam, 2007). Alternatively, difficult interactions with computer interfaces (e.g. webinars, learning software) depress the effectiveness of online learning (Swan, 2003). An introductory computer literacy class before an online training series may benefit participants. It would be useful in designing 7(j) training sessions to know more about the level of computer literacy of potential 8(a) training participants. Building in time for computer literacy training might greatly improve the 7(j) training outcomes. Currently, the available data from the 7(j) program does not contain information on computer literacy of its participants; as a result, the study was not able to test this relationship with program outcomes.

***Task-related content:*** There is mixed opinion on what type of content is most effectively delivered through online training. Lim, Lee, and Nam (2007) state that task-related content



during trainings increases real-world performance because students get a chance to put theory to practice. However, Wang and Hsu (2008) find that online learning is most appropriate for delivering conceptual knowledge or basic procedural knowledge, and that heavy cognitive loads such as hands-on skills do not benefit as much as through in-person means. This effect is compounded as the participant count within the online class increases because the instructor is not able to give students who struggle as much personal assistance. The study attempted to understand this phenomenon by exploring the type of classes taken, at what stage of the 8(a) program, and by whom.

***Instructors' attitudes:*** Research has found that student learning motivation is strongly associated with the course instructor's attitude, organization, and interaction (Sun, Tsai, Finger, Chen, & Yeh, 2008). Because participants self-select, students' motivation in 7(j) online training courses is generally high. However, instructor attitude plays an important role in how participants perceive the course and learning material and may affect how participants digest and utilize the course material. The study attempted to measure learning motivation indirectly by using quantitative and qualitative data gathered on course ratings and interviews of instructors.

***Entrepreneur Characteristics:*** As with many other endeavors, training programs may have disproportionate positive and negative effects based on key demographic or behavioral characteristics. For instance, research shows that African-Americans seem to value business training more than non-African-Americans (Martin, Wech, Sandefur, & Pan, 2006). One hypothesis is that African Americans do not have access to the same volume of resources to acquire financial capital, as their counterparts. As such, entrepreneurship training has a larger impact on minorities than non-minorities in terms of maintaining long-term engagement with entrepreneurial activity (Lyons & Zhang, 2017). Minorities appear to disproportionately benefit from such training because, all else being equal, the programs offer resources and knowledge that are more difficult for disadvantaged groups to obtain (Mick & Greene, 2004). To understand this phenomenon, the research team explored the relationship of business characteristics, which included the minority status of the business owner, on the decision to attend any 7(j) training, and the type of classes taken in answering the first research question.

## **Data Sources and Preparation**

To answer the research questions, the team developed a master analytical dataset by linking data elements from the administrative data stores of the 8(a) business portfolio, 7(j) online training, and federal contract awards for FY2014-FY2017.

***Data Sources:*** The data sources used to create the master analytical dataset are briefly described below.

1. **Trainings offered and 8(a) attendees, FY2014-FY2017:** The training data contains information on the date, length, topic, and instructor of each online training. Training attendee name and contact information is provided separately for each course and includes 8(a) and non-8(a) participants. The 8(a) participants include those that started the program between 2013 and 2017.
2. **Attendee course ratings, FY2014-FY2017<sup>2</sup>:** The course feedback survey contains five standard questions on the perceived effectiveness of the course given its stated objectives. The surveys have historically received a 50 percent response rate. Importantly, the course name and date are included in the data, but the respondents are not identified and cannot be linked to their contract outcomes.
3. **8(a) participant intake data, FY2006-FY2017:** The participant intake data is collected through the Form 1010 and come from SBA's Business Development Management Information System (BDMIS).<sup>3</sup> The data file(s) include business identifiers and a select few additional variables on the form (e.g., the race and gender of the owner, the hours spent on the business, whether it is co-owned, and the business location).
4. **8(a) participant annual review data, FY2006-FY2018:** The annual review data is collected through the Form 1450 and comes from SBA's e8(a) Review system.<sup>4</sup> Although the form includes three attachment forms and several supporting documents, the data file contains a subset of this information (e.g., 8(a) and non-8(a) sales, assets and liabilities, loans, taxes paid).
5. **8(a) participant mentor-protégé and joint venture data, FY2010-FY2018:** This dataset contains information on active mentor-protégé agreements approved between FY2010 and FY2018 and joint-venture agreements approved between FY2012 and FY2018. It includes information on the individual businesses within these agreements and the agreement expiration date.
6. **Training instructor interviews:** Interviews were used to gather contextual information to strengthen interpretation of the training data received from Stover. The research team sought to better understand the intent, operation, changes in implementation, and expected impact of trainings. The research team interviewed a sample of six instructors and administrators who were active and involved in the curriculum design during the fiscal years under study.
7. **Federal Procurement Data System – Next Generation (FPDS-NG), FY2013-FY2017:** FPDS-NG contains federal contracting information. The data covers 13 modules, such as Contract Dollar Values, Product or Service Information, Purchaser Information, Contractor Data, and Competition Information, which provide detailed information on contract awards obtained by 8(a) businesses. The SBA maintains a static version of the FPDS-NG as of October of each year called the Small Business Goaling Report (SBGR)

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<sup>2</sup> The research team found that the data on course rating did not have sufficient variation across courses to provide meaningful information on which courses the attendees found most helpful. As a result, the research team did not include course rating data in the analysis.

<sup>3</sup> According to SBA, BDMIS data are no longer available and information has been transferred to a new data system, Certify.gov.

<sup>4</sup> Data from annual reviews are uploaded or manually entered by the Business Office Specialist from BDMIS to the e8(a) Review system, [https://www.sba.gov/sites/default/files/files/E8\(a\).pdf](https://www.sba.gov/sites/default/files/files/E8(a).pdf). According to SBA, the timeline and completeness of the data transfer varies by District Office and BOS. Recently, annual review data have also been transferred to Certify.gov however, they are not accessible in database format. As a result, information from annual reviews used for this study may be incomplete.

which excludes contracts that are not small business eligible. The study uses the SBGR version of the FPDS-NG.

- 8. System for Award Management (SAM), FY2014-FY2017:** SAM contains data elements pertaining to business profiles of businesses that are interested in and are currently doing business with the federal government. The study used For Official Use Only (FOUO) version of historical SAM data extract for the month of October for fiscal years 2014 to 2017 to fill in missing information on business characteristics of 8(a) businesses.

**Data Preparation:** The research team prepared the master analytical dataset by first merging the discreet 8(a) business data sources by their Data Universal Numbering System (DUNS) number and fiscal year and then merging the discreet 7(j) training data sources using the same matching key. The team then merged the composite 8(a) business and 7(j) training datasets together by DUNS number and fiscal year. The next step involved collapsing the contract action level FPDS-NG data to individual DUNS numbers for each fiscal year and then merging the FPDS-NG data elements to the selected SAM data elements by DUNS number for each fiscal year. This created a composite dataset that contained business characteristics and federal contracting information. The last step involved merging the composite SAM and FPDS-NG data to the composite 8(a) business and 7(j) training data to create the master analytical dataset.

## Research Design

Using the master analytical dataset described in the previous section, the research team trained unsupervised and supervised machine learning algorithms, developed a quasi-experimental model using statistical matching, and conducted multivariate linear regression analysis to answer the three research questions respectively.

### Research question 1: What are 8(a) participants' pattern of attendance in 7(j) online trainings and why do they start, stop, or never attend the training?

**Hypotheses:** The study attempted to answer the research question by testing the following hypotheses:

1. Businesses that elect to take part in the 7(j) training differ from those that do not;
2. Businesses that are likely to take different courses or course sequences within the 7(j) training program likely differ in the characteristics; and
3. Select characteristics of 8(a) businesses can be identified as predictors of 7(j) program participation and attendance.

**Methodological Approach:** The study began answering the research question by testing the first hypothesis of whether 8(a) businesses which took part in the 7(j) training differed from those that

did not. Narrowing the exploratory analysis to only small businesses in their first year of the 8(a) program during FY2014-FY2017 from the master dataset, the analytical approach involved conducting k-means clustering analysis, an unsupervised machine learning technique, to group or cluster businesses based on their characteristics. Once the clusters of similar businesses were created, the research team examined the businesses characteristics in each cluster to identify what made each business within each cluster similar as well as identify characteristics that made businesses across clusters different. The unit of analysis for this clustering model are 8(a) businesses.

Next, the study explored the pattern of 7(j) online training courses taken by 8(a) businesses to test the second hypothesis of whether businesses that took certain courses, or course sequences differed from one another. Narrowing the analysis from the master dataset to only include the FY2014 8(a) cohort that took part in 7(j) training in FY2014-FY2017, the analytical approach involved conducting k-means clustering analysis to group businesses based on their course taking pattern in their first program year as well as their first four years in the 8(a) program. Given the exploratory nature of the analysis, the research team wanted to follow the course taking patterns of a single cohort, namely FY2014, whose course taking data were available for all four years of phase 1 in the 8(a) program<sup>5</sup>. Once the clusters of similar businesses were created based on courses taken, the research team examined the characteristics of the businesses in each cluster to identify what made them similar and examined the characteristics of businesses across clusters to identify what made them different. The unit of analysis for this clustering model is 8(a) businesses.

Lastly, the study answered the research question by testing the third hypothesis of whether select characteristics of 8(a) businesses can predict whether they participate in the 7(j) training program. Again, narrowing the analysis from the master dataset to only small businesses in the first year of the 8(a) program during FY2014-FY2017 to form the analytical dataset, the approach involved training a random forest decision analysis algorithm, an ensemble supervised machine learning technique, to predict which 8(a) businesses would participate in the 7(j) training and which of their business characteristics have the most predictive power. To develop the model, the research team randomly selected businesses from the analytical dataset to form a training set comprised of 70 percent of the observations and a testing set with 30 percent of the observations. The team then trained a random forest algorithm to predict whether businesses in the training set participated in the 7(j) program based on their business characteristics. Once the algorithm was trained, the research team used the algorithm to test how well it could predict whether businesses in the testing set (data the algorithm had not seen) participated in the 7(j) program. The unit of analysis for this model is 8(a) businesses, the dependent variable is 7(j) training participation, and the independent variables are business characteristics.

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<sup>5</sup> The nine year-long 8(a) program is split into two phases. The first four years is phase 1, which is the developmental stage. The final five years is phase 2, which is the transitional phase.



## **Research question 2: What characteristics of 8(a) firms and 7(j) online trainings relate to obtaining a (first) federal contract?**

**Hypotheses:** The methodological approach to answer the second research question was shaped by the following hypotheses:

1. Participating in the 7(j) training program increase the odds of winning a federal contract when taken in full, by younger businesses, prior to year 4 in the 8(a) program;
2. Participating in the 7(j) training program decrease the time to a business's first federal contract win;
3. Participating in the 7(j) training program increase the odds of winning a federal contract when the participant's knowledge and understanding of contracting improves;
4. Participating in the 7(j) training program increase the odds of winning a federal contract when the participant obtains feedback on applying the knowledge to their business during and after the course; and
5. Participating in the 7(j) training program increase the odds of winning a federal contract when the participant also obtains hands-on proposal practice.

**Methodological Approach:** The research team developed a quasi-experimental model using statistical matching to test the first hypothesis and answer the overall research question. The team filtered the master dataset to keep only small business on their first year of the 8(a) program during FY2014-FY2017. Then the team employed a statistical matching technique called Coarsened Exact Matching (CEM) to match 8(a) business that did not take 7(j) training to those that did based on select<sup>6</sup> business characteristics because 8(a) businesses that participate in 7(j) training likely have different business characteristics than the population of 8(a) businesses that did not. Comparing the outcomes of a matched set of businesses improved the validity of the model so that it better isolates the impact of 7(j) training. The team then estimated the Sample Average Treatment Effect on the Treated (SATT) to assess whether 8(a) businesses with 7(j) training have a higher likelihood of obtaining a federal contract than those that did not.

To test the second hypothesis, the research team assessed whether 8(a) businesses with 7(j) training obtained federal contracts at a different pace than those that did not. The team conducted time-to-event or survival analysis on the matched sample of 8(a) businesses using the number of days between attendance of the first training session and signing of the first federal contract after attendance to assess whether 7(j) training led businesses to obtain federal contracts at a faster rate.

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<sup>6</sup> The business characteristics used for the CEM matching were average annual revenue, business age, number of employees, whether the business was located in the Washington, D.C. area, primary industry, and whether they already had a federal contract prior to joining the 8(a) program.

While the first two hypotheses attempted to measure the overall effectiveness of the 7(j) training and the pace at which contracts were obtained, the remaining hypotheses aimed at understanding the mechanism of how the 7(j) training worked by assessing the impact of specific training topics. The methodological approach to test the remaining hypotheses lay in replicating the design for measuring the overall effectiveness of the 7(j) training for specific marketing and contracting topics that align with the last three hypotheses by conducting the CEM matching to develop comparable control groups and estimating the SATT of those topics.

The unit of analysis is 8(a) businesses, the independent variables used to conduct the matching were business characteristics, the variable of interest was participation in 7(j) training, and the dependent variable for the impact analysis was obtaining federal contracts and for the survival analysis was the rate at which the event of obtaining a federal contract occurred.

### **Research question 3: To what extent is 7(j) online training related to meeting business activity (non-8(a) contract) targets?**

**Hypotheses:** The research question was answered by testing the following hypotheses:

1. Businesses in phase 2 of the 8(a) program are more likely to meet the businesses activity targets than those in phase 1; and
2. Participating in the 7(j) training program increases the ability of phase 2 businesses in meeting the businesses activity targets than those without training.

**Methodological Approach:** The research team developed a multiple linear regression model with a difference in difference approach to test the hypotheses and answer the third research question. Specifically, the team assessed whether participation in 7(j) training had an impact on the percent of non-8(a) contract dollars in the federal revenue portfolio of small businesses in phase 2 of the 8(a) program compared to those with training in phase 1 as well as those without training in both phases. The research team prepared the data by filtering the master dataset to keep only small businesses that entered the 8(a) program in FY2010 and FY2014 and only kept observations of these businesses for FY2014-FY2017. This was done to create a pool of businesses with complete training data from phase 1 of the 8(a) program, in this case the FY2014 cohort; and to create a pool of businesses with the most training data from phase 2, in this case the FY2010 cohort. The unit of analysis was 8(a) businesses by fiscal year, the independent variables were business characteristics, the variables of interests were phase and training participation, and the dependent variable was the percent of non-8(a) contract dollars in the federal revenue portfolio.

Lastly, the research team relied on the qualitative data gathered through instructor interviews to provide context to the findings of the models used to answer each of the research questions where appropriate.

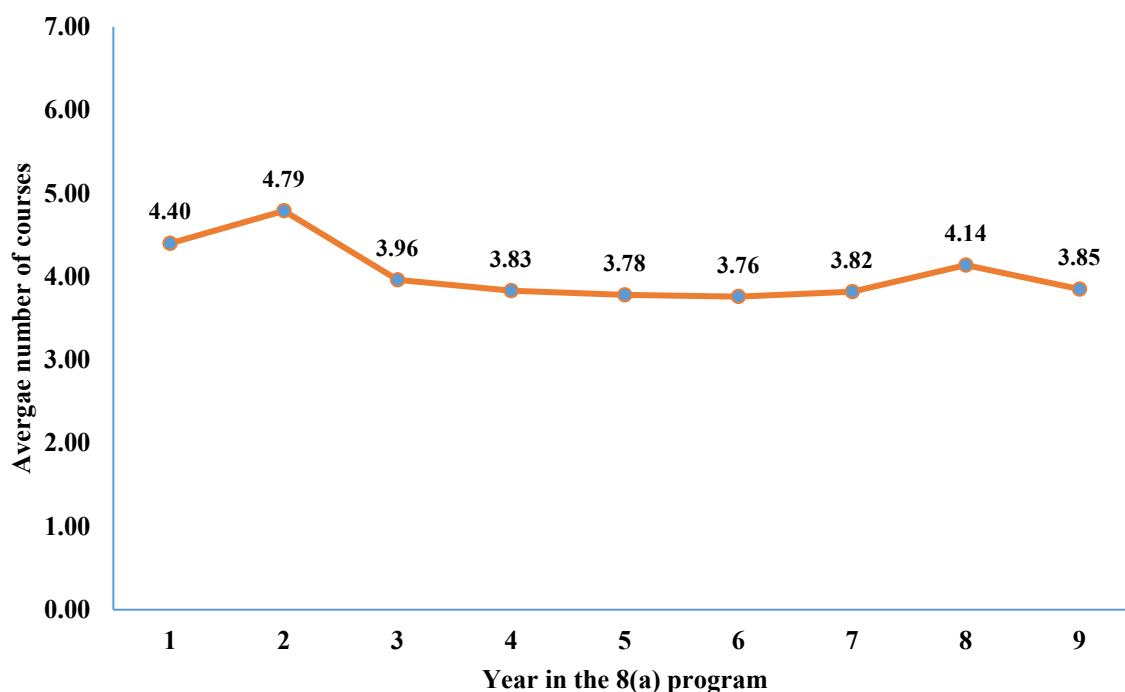
# Findings

The findings of the study are discussed in detail below.

## Research question 1: What are 8(a) participants' pattern of attendance in 7(j) online trainings and why do they start, stop, or never attend the training?

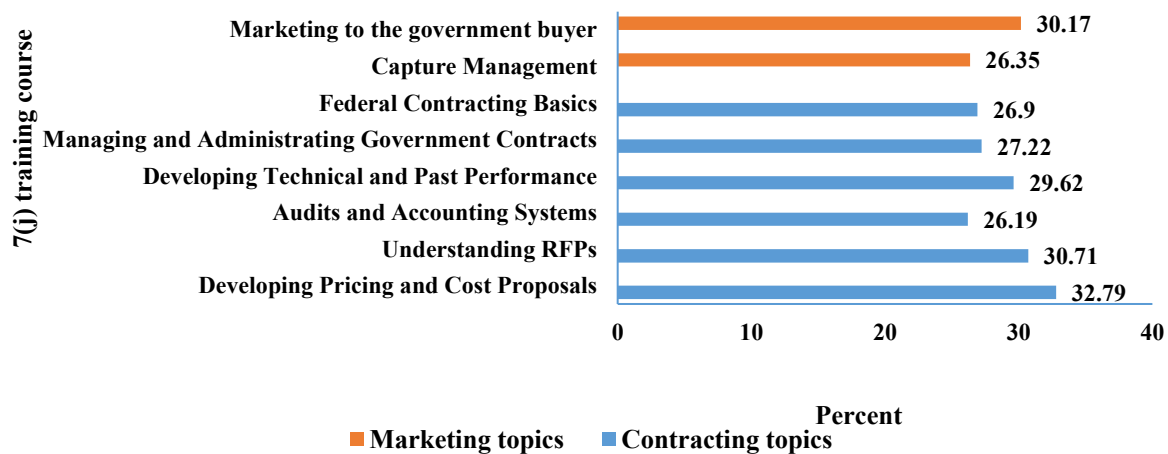
As of September 2018, 19,061 businesses were active in at least one phase of the 8(a) program between fiscal years 2014 to 2017. Of these business, 1,833 of them or 9.62 percent attended one or more 7(j) online training courses. On average, 8(a) businesses attended a little over four online courses. Figure 3 displays the average number of courses taken, and Figure 4 shows the most common<sup>7</sup> courses taken by phase 1 8(a) businesses. From Figure 4 it is clear that businesses that took 7(j) training were primarily interested in marketing and contracting courses.

Figure 1: Average number of 7(j) courses taken by businesses in the 8(a) program



<sup>7</sup> Courses taken by at least one in four of the training participants.

Figure 2: Most common courses taken by phase 1 businesses<sup>8</sup>

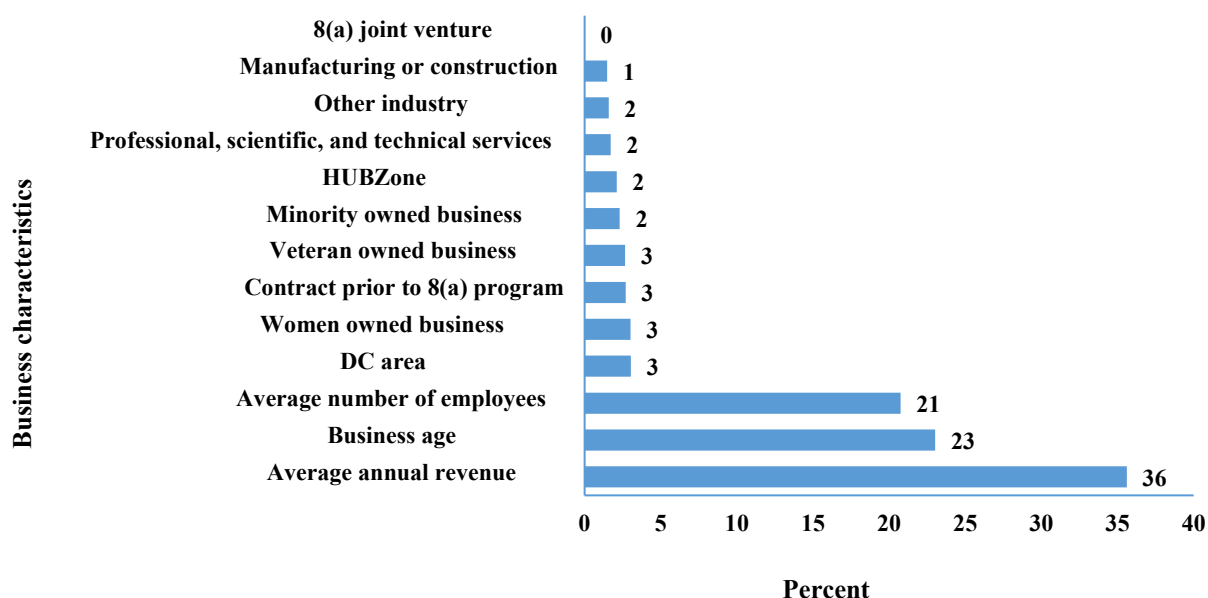


To further understand the attendance of 7(j) training, the research team conducted exploratory clustering and random forest machine learning analysis. To identify whether 8(a) businesses that took part in 7(j) training differ in characteristics than those that did not, the team conducted clustering analysis on the characteristics of 8(a) businesses, using a cluster size of two, to determine how well it grouped the businesses into training and non-training clusters. The results proved inconclusive as only 49 percent of 8(a) businesses in the first year of the program during FY2014-FY2017 could be accurately categorized into training and non-training clusters using their underlying characteristics.

The research team then trained a random forest algorithm to predict which 8(a) businesses would participate in 7(j) training and identify the business characteristics with the most predictive power. The algorithm predicted with 70 percent accuracy which 8(a) businesses in the first year of the program during FY2014-FY2017 took part in 7(j) training. The algorithm identified average annual revenue, business age, and the average number of employees as the most important predictors of attending 7(j) training, respectively. Developing a random forest model with these three variables, the research team predicted attendance of 7(j) training with 65 percent accuracy. Figure 5 illustrates the relative importance of business characteristic variables to predict 7(j) training attendance. These results show that the characteristics of 8(a) businesses vary between the firms that took 7(j) training and those firms that did not. While the random forest model is able to predict participation into the 7(j) program and identify the business characteristics that predict participation, it is not able to provide clear insight on the specific mechanism of how these businesses characteristics individually or in certain combinations effect program participation.

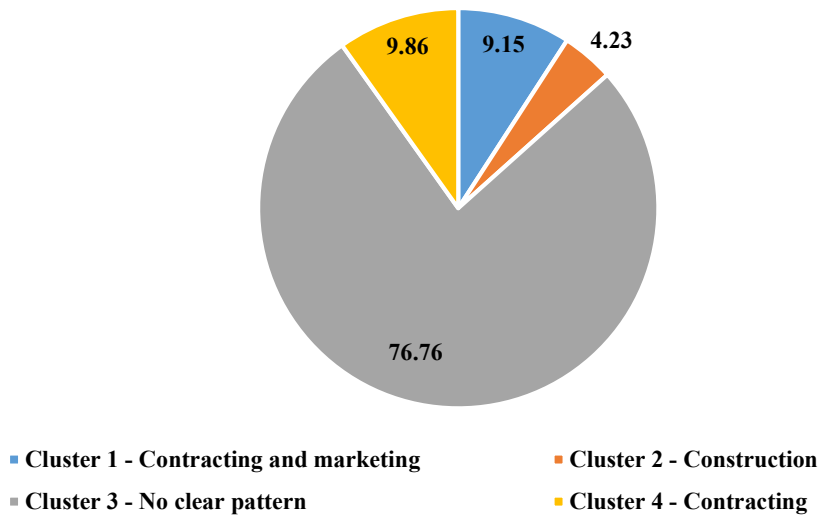
<sup>8</sup> Course taking pattern of businesses in phase 2 of the 8(a) program was not assessed as part of the exploratory analysis and therefore not reported in the study.

**Figure 3: Relative importance of business characteristic variables on predicting 7(j) training attendance**



The research team conducted clustering analyses on the 7(j) training courses taken by the FY2014 cohort of the 8(a) program during their first year and first four years in the program to identify whether businesses that take certain types or clusters of courses differ in characteristics than those that take others. The clustering analysis on courses taken during the first year in the 8(a) program grouped businesses into four distinct clusters illustrated in Figure 6. The first cluster consisted of 8(a) businesses that took around one course each on marketing and contracting topics; the second cluster consisted of businesses that took at around one course on construction topics; the third cluster consisted of businesses that did not have any clear pattern; and the fourth cluster consisted of businesses that took at around one course on contracting topics. Table 1 illustrates the businesses characteristics in each cluster. Table 1 shows that businesses in the first cluster took mostly marketing and contracting courses but did not include businesses in the Manufacturing and Construction sectors. Businesses in the second cluster that mostly took construction courses were primarily Manufacturing and Construction firms. While 8(a) businesses in the third and fourth clusters had similar industry composition, the average annual revenue of businesses in the fourth cluster was half of that of the third, and unlike the third cluster which did not have any clear courses taking pattern, businesses in the fourth cluster mainly took contracting courses. The cluster analysis shows that almost all 8(a) businesses in their first year in the program belonged to the third cluster and did not have any clear course taking pattern. This finding is not surprising as it may take longer than a year to develop a pattern.

**Figure 4: Number of clusters and percent of businesses in each cluster of courses taken by phase 1 business in their first year in the 8(a) program**



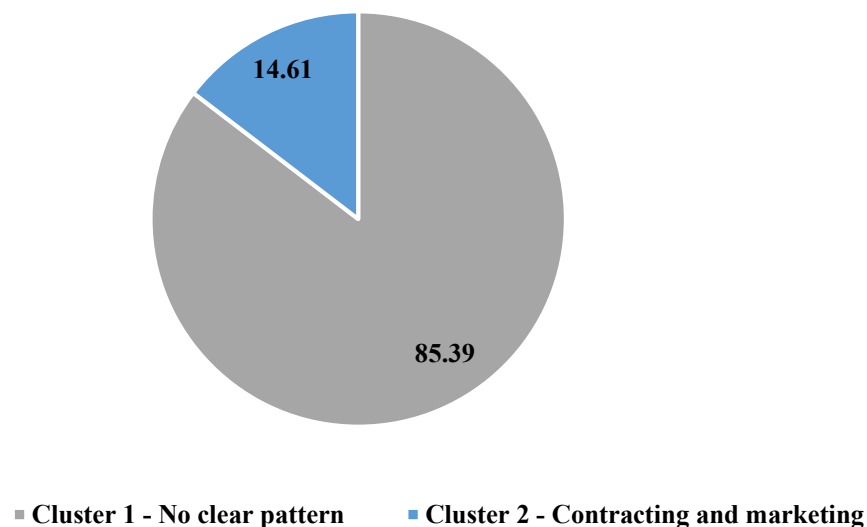
**Table 1: Cluster analysis of courses taken by phase 1 businesses in their first year in the 8(a) program**

Cluster	One	Two	Three	Four
Course taking pattern	Contracting and marketing	Construction	No clear pattern	Contracting
Business characteristics variables	Mean	Mean	Mean	Mean
<i>Age of the business in years</i>	7.38	8.33	8.87	7.64
<i>Year in the 8(a) program</i>	1.00	1.00	1.00	1.00
<i>Located in the Washington, D.C. MSA</i>	0.54	0.17	0.23	0.14
<i>Had a contract prior to joining the 8(a) program</i>	0.38	0.50	0.37	0.21
<i>Number of employees</i>	5.46	5.17	12.08	3.71
<i>Average annual revenue for the past three years (\$)</i>	578,841.69	1,918,494.00	1,211,445.00	599,075.00
<i>Minority-Owned Small Business</i>	1.00	0.83	0.83	0.93
<i>Veteran-Owned Small Business</i>	0.38	0.33	0.20	0.07
<i>Women-Owned Small Business</i>	0.38	0.00	0.40	0.29
<i>8(a) business with joint venture</i>	0.00	0.00	0.00	0.00
<i>HUBZone business</i>	0.00	0.17	0.04	0.00
<i>Primary industry is Manufacturing or Construction</i>	0.00	0.83	0.28	0.21
<i>Primary industry is Professional, Scientific, and Technical services</i>	0.62	0.00	0.52	0.57
<i>Primary industry is other</i>	0.38	0.17	0.19	0.21
<b>Number of observations</b>	<b>13</b>	<b>6</b>	<b>109</b>	<b>14</b>

The clustering analysis on 7(j) training courses taken during the first four years in the 8(a) program of the FY2014 cohort grouped businesses into two different clusters as illustrated in Figure 7. While the second cluster consisted of businesses that took around one course each on marketing and contracting topics, the first cluster with most of the businesses, did not have any clear course taking pattern. Table 2 illustrates the characteristics of businesses that belonged to these two clusters. From Table 2 it is evident that the businesses that comprise the second cluster had a higher percentage of businesses in the Professional, Scientific, and Technical Services industry and lower percentage of businesses in other industries, and on average had annual revenues \$150,000 higher than the other cluster with 8(a) businesses with no clear course taking pattern.

Qualitative data gathered through interviews with 7(j) training instructors provide additional context on course taking pattern of 8(a) businesses. Instructors shared that using the interactive chat feature of the webinar tool, they tend to provide recommendations to participants on what courses they should take next based on their industry and interest. Moreover, the instructors added that participants also interact with each other using the chat feature on a number of topics including discussions on future course taking. The instructors noted that businesses that took more than one course usually took a sequence of courses on related topics while business that took a single course were most likely looking for training on something specific. At times, businesses repeated the same course to better understand the topic and may take certain courses as a refresher, particularly those on contracting topics. These insights from the instructors overall align with the findings of the exploratory analysis and provide valuable context on how to interpret the findings.

**Figure 5: Percent of businesses in each cluster of courses taken by phase 1 businesses in their first four years in the 8(a) program**



**Table 2: Cluster analysis findings for phase 1 business in their first four years in the 8(a) program**

Cluster	One	Two
<b>Course taking pattern</b>	<b>No clear pattern</b>	<b>Contracting and marketing</b>
<b>Business characteristics variables</b>	<b>Mean</b>	<b>Mean</b>
<i>Age of the business in years</i>	10.06	9.77
<i>Year in the 8(a) program</i>	2.49	2.51
<i>Located in the Washington, D.C. MSA</i>	0.25	0.28
<i>Number of employees</i>	12.84	12.18
<i>Average annual revenue for the past three years (\$)</i>	1,574,121.00	1,730,246.00
<i>Minority-Owned Small Business</i>	0.86	0.90
<i>Veteran-Owned Small Business</i>	0.21	0.27
<i>Women-Owned Small Business</i>	0.38	0.36
<i>8(a) business with joint venture</i>	0.00	0.00
<i>HUBZone business</i>	0.10	0.07
<i>Primary industry is Manufacturing or Construction</i>	0.28	0.23
<i>Primary industry is Professional, Scientific, and Technical Services</i>	0.50	0.63
<i>Primary industry is other</i>	0.22	0.14
<b>Number of observations</b>	<b>485</b>	<b>83</b>

## Research question 2: What characteristics of 8(a) firms and 7(j) online trainings relate to obtaining a (first) federal contract?

The study found that participating in 7(j) training not only increases the likelihood of 8(a) businesses obtaining a federal contract, but it also increases the rate at which they obtain the contract. Specifically, the SATT analysis using the matched sample of 8(a) businesses found that 8(a) businesses with 7(j) training were 12 percentage points more likely to obtain a federal contract than those that did not. This increases the likelihood of obtaining federal contracts for 8(a) businesses from 47 percent to 59 percent.

The survival analysis using the matched sample found that the rate of obtaining a federal contract for 8(a) businesses with 7(j) training was 14 percent higher than those that did not take training. The 14 percent higher rate of obtaining a federal contract is approximately 77 days. This means that 8(a) business with 7(j) training obtain contracts on average within 511 days from the date of first training while those similar businesses without training take on average 588 days to obtain contracts. Therefore, 7(j) training helps 8(a) businesses to obtain federal contracts 77 days faster than those without training. While the overall effectiveness of the training and its effect on the time to obtain contracts were measured, the study did not test the last three hypotheses that aimed at understanding specific mechanisms of the training. However, as the most frequently enrolled courses, taken by at least one in four participants, included the ones on marketing and

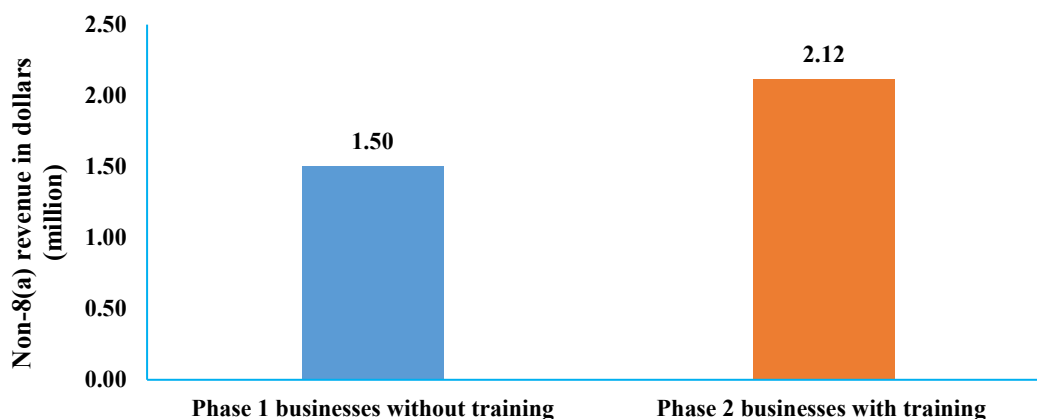


contracting that align with the last three hypotheses, the overall finding that 8(a) businesses with 7(j) training were 12 percentage points more likely to obtain a federal contract, indirectly confirmed these hypotheses.

### **Research question 3: To what extent is 7(j) online training related to meeting business activity (non-8(a) contract) targets?**

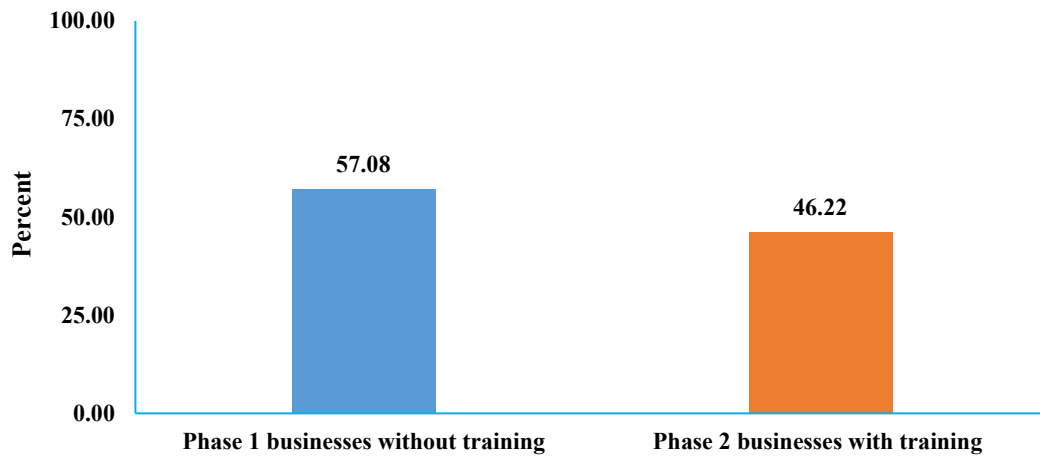
The study found no relationship between 7(j) online training and meeting business activity targets of obtaining non-8(a) contracts. The results show that while phase 2 businesses, both with and without training, have higher non-8(a) federal contract dollars than phase 1 businesses, the percent of non-8(a) revenue in the federal portfolios of phase 2 businesses is lower than that of phase 1 businesses as illustrated in Figures 8 and 9. Table 3 presents this finding in detail. 7(j) online training attendance had no effect on the percent of non-8(a) revenue in the federal portfolios of phase 2 business compared to phase 1 businesses without training. Interviews with training instructors revealed that while all businesses, including those that are non-8(a), took 7(j) online training to increase their chances of competitively winning federal contracts, many of the courses are built towards meeting the needs of the 8(a) community. The instructors shared that modules of certain courses are tailored towards 8(a) businesses. For instance, the teaming course describes the 8(a) mentor protégé and joint venture programs and discusses the relative advantages of such partnerships. Moreover, instructors receive a lot of questions on 8(a) contracting across different courses which they answer directly to the businesses as well as sharing them to the entire class. These insights from the instructors indicate that 7(j) training may differentially benefit 8(a) businesses particularly in obtaining contracts through 8(a) specific vehicles.

**Figure 6: Non-8(a) federal contracting revenue of select<sup>9</sup> phase 1 and 2 8(a) businesses**



<sup>9</sup> The analysis sample composed of phase 2 data from FY2010 cohort and phase 1 data from FY2014 cohort for FY2014-FY2017.

**Figure 7: Percent of federal contracting revenue from non-8(a) contracts of select phase 1 and 2 8(a) businesses**



**Table 3: Non-8(a) federal contracting revenue and percent of federal contracting revenue from non-8(a) contracts of select<sup>10</sup> phase 1 and 2 8(a) businesses**

	Non-8(a) federal contracting revenue in dollars	Percent of federal contracting revenue from non-8(a) contracts	No. of observations
Overall sample	\$1,861,458	49.28	3,925
Overall phase 1 businesses	\$1,487,935	56.84	1,559
Overall phase 2 businesses	\$2,107,579	44.30	2,366
All businesses without training	\$1,877,878	49.03	3,537
Phase 1 businesses without training	\$1,500,197	57.08	1,335
Phase 2 businesses without training	\$2,106,855	44.16	2,202
All businesses with training	\$1,711,769	51.54	388
Phase 1 businesses with training	\$1,414,855	55.44	224
Phase 2 businesses with training	\$2,117,309	46.22	164

## Limitations

The findings of this study are limited by the quality and completeness of the data used and the methodological challenges faced in modeling factors that could not be directly measured. While the 7(j) training program is offered by a number of vendors both in-person and on-line, the findings are limited to the on-line training provided by Stover. Therefore, this evaluation and its findings are not representative of the overall 7(j) program but reflective of only the 7(j) online training program offered by Stover whose data were logistically easier to obtain due to the web-based platform used to administer the training.

<sup>10</sup> The analysis sample composed of phase 2 data from FY2010 cohort and phase 1 data from FY2014 cohort for FY2014-FY2017.

For the first research question, the findings of the exploratory machine learning analysis were based on training one-type of algorithm for each type of analysis, namely k-means clustering and random forest. For instance, understanding the characteristics of 8(a) businesses who join 7(j) training and their course taking pattern could have been further analyzed by using methods like hierarchical clustering and partition around medoids (PAM) clustering in addition to the k-means to provide more robust results. Similarly, the analysis to predict the enrollment of 8(a) businesses into 7(j) training could have been carried out by training support vector machines (SVM) and naïve Bayes algorithms in addition to random forest to obtain better predictions. Additionally, step-wise or lasso regression models could have been developed on top of random forest to further identify predictors of enrollment into training. As this was intended to be exploratory, the research team only trained a single type of algorithm for each type of analysis and chose k-means for clustering and random forest for prediction as they were the most robust and efficient approach. In terms of scope and use of data, the study limited the exploratory analysis to just businesses in phase 1 of the 8(a) program as more complete data on phase 1 were available. Also, while data on course rating were available, the research team found that the data did not have sufficient variation across courses to provide meaningful information on which courses the attendees found most helpful. As a result, the research team did not include course rating data in the analysis. Lastly, while the random forest algorithm identified the three variables as characteristics that predict 7(j) training attendance, the findings do not provide sufficient insight into what thresholds or factors within each variable or across determine training attendance. Since a random forest model is comprised of individual decision trees that make up the “forest”, understanding how each variable individually, and in concert with other variables model the decision to take part in 7(j) training can be done by studying individual decision trees. However, since the composition of each tree is likely to be different and as the results of the overall random forest is based on ranking or voting of importance of each variable from all trees, studying the composition of each tree would not provide the overarching decision rule of the predictive variables. Thus, while the random forest algorithm is able to predict participation into the 7(j) program with a degree of certainty, as well as identify the business characteristics with the most predictive power, it is not able to isolate what specific attributes of those business characteristics drive their participation into the program.

For the second research question, the CEM statistical matching technique was used to select a sample of 8(a) businesses that did not participate in 7(j) training but were comparable in characteristics to those that took training based on a select few business characteristics. The select businesses characteristics for the CEM matching were the average annual revenue, business age, number of employees, whether the business was located in the Washington, D.C. area, primary industry, and whether they already had a federal contract prior to joining the 8(a) program. While the matching could have been performed using additional business characteristics to generate statistically closer matches, it would have reduced the number of 8(a)

businesses with training in the matched sample as matched pairs of business without training could not be found for all the businesses that took the training. Excluding more than 10 percent of businesses with training in the analysis would reduce the representativeness of the findings and the generalizability of the recommendations. The matching approach used for analysis led to the loss of less than 4 percent of businesses with training and had a near perfect match with 8(a) businesses without training based on the select business characteristics. Therefore, the findings should be generalizable to the entire population of 8(a) businesses with 7(j) training.

During the data preparation phase of the statistical matching, the research team encountered many observations of the select business characteristics with missing values. To address missing observations, the CEM approach allows missing values to be treated as a valid response category within variables. The study treated the missing values of observations in businesses both with and without training as a valid response category to perform the matching to avoid losing training businesses from the analysis sample. Imputing missing values in this manner may affect the validity of the matching and the findings.

For the survival analysis, the time taken to obtain a contract was calculated as the time between the date of attending the first training session of the 7(j) training program and the date of signing the next federal contract. During the data preparation phase, the study found that the date of the first training session was not available for all the participating 8(a) businesses. As no clear pattern of date of first training session could be identified based on course taking pattern within a fiscal year, the study imputed the missing dates with the median date of first training sessions of business whose date was available within a fiscal year. Since businesses that did not take part in 7(j) training do not have a date of first training, the study had to assign an estimated date to calculate their time to obtain a federal contract. As each non-training business was statistically matched to one or more businesses that took training, the study assigned the date of first training of the matched business that took training to the businesses that did not take the training to estimate the time to obtain a federal contract. Also, as the calculation for estimating time to obtain a federal contract did not account for any lag period between attending the first training session, implementing the lessons from training in business practices and business development approach, and then obtaining a federal contract, the findings of the survival analysis may be biased and be presenting an inflated effect.

The study was only able to directly answer the overarching question of whether 7(j) training has an impact on 8(a) businesses obtaining federal contracts and the rate of at which they are obtained. It was not able to directly test the last three hypotheses that aimed at understanding the specific mechanisms of the 7(j) training program. Further research needs to be conducted to isolate the effect of each course on receiving federal contract awards to fully understand the theory of change of the 7(j) online training program. The methodological approach developed to test the first two hypotheses can be adapted to directly test the last three hypotheses.

For the third research question, a difference in difference (DiD) regression model was used to assess the impact of 7(j) online training on obtaining non-8(a) contracts. While the DiD model included business characteristics as control variables to account for differences in the underlying characteristics of 8(a) business with and without 7(j) training, not all characteristics may have been accounted for by the model. Also, as complete information on business characteristics of all 8(a) businesses, particularly those pertaining to additional SBA or other certifications was not available, the observations with missing information were not included in the model. The sample of 8(a) businesses with and without training used in the analysis consisted of businesses that joined the program in FY2010 and FY2014 and included their observations for FY2014-FY2017. In other words, FY2014-FY2017 observations for the FY2014 cohort captured phase 1 business activity and captured phase 2 activity for the 2010 cohort, namely years five to eight in the 8(a) program. Since data were not available beyond fiscal year 2017, complete data for a phase 2 cohort, in this case year nine for the FY2010 cohort, could not be used in the analysis. These data limitation may affect the representativeness of the findings and the generalizability of the recommendations.

## Conclusions and Recommendations

The research team conducted statistical and machine learning analysis to answer the research questions. The major findings and recommendations for improving the performance of the 7(j) training program are presented below.

**Major Findings:** The research team found that business characteristics differed between 8(a) businesses that did not participate in 7(j) training, compared to 8(a) businesses that took 7(j) training. Results show that these variations in business characteristics between trainee businesses and non-trainee businesses can be used to predict which 8(a) businesses would participate in 7(j) training. The random forest analysis found that three business characteristics – annual revenue, business age, and number of employees – predicted whether a business would participate in 7(j) training courses with 70 percent accuracy. However, these results do not provide clear insight as to what attributes or thresholds of those business characteristics vary between the two groups.

The study found on average, businesses that participated in training enrolled in 3 to 5 courses annually. Training was highly concentrated across a handful of courses. Based on the cluster analysis, the research team was able to group which courses or cluster of courses businesses that participated in training were most likely to take. For instance, a business' industry seems to be an important predictor of which 7(j) courses are taken. The cluster analysis shows that businesses in Professional, Scientific, and Technical Service industry are more likely to participate in training courses related to federal contracting and marketing to government customer compared to 8(a) businesses in the manufacturing and construction sectors. However, the robustness of the

relationship between industry sector and training courses taken by 8(a) businesses is complicated. The group with the largest number of businesses does not appear to have any clear topical course preferences.

For the period of analysis of this study, FY2014-FY2017, the research team found that 7(j) training is associated with a 12 percentage point greater probability of obtaining federal contracts for businesses that received training compared to businesses that did not receive training. The results also show that businesses that received training obtained federal contracts at a 14 percent higher rate or at a pace of 77 days faster than those that did not.

Lastly, the study found no relationship between 7(j) online training and meeting business activity targets of obtaining non-8(a) contracts.

**Recommendations:** The following recommendations could help to improve the performance of the 7(j) online training program based on the findings:

1. The SBA should consider highly encouraging 8(a) businesses to take part in the 7(j) online training.
2. Given that 7(j) participants appeared to take courses based on similar topics, the SBA could make these courses more attractive to potential 8(a) businesses by grouping them into modules. For instance, instead of presenting individual courses on federal contracting or marketing to the Federal Government, develop course sequences on contracting and marketing based on the ones most commonly taken.
3. Target and promote the newly developed course sequences to 8(a) businesses based on their industry or industry sector when encouraging them to enroll in 7(j) online training.
4. This study indicates where additional knowledge might improve the effectiveness of the 7(j) online training program:
  - a. 8(a) businesses that received training were more likely to receive federal contracts than businesses that did not receive training. However, it was beyond the scope of the study to assess whether receiving more contracts is associated with better short-term or long-term business performance. Interviews with instructors revealed that much of the course work dealt with not only tools on how to obtain a federal contract, but on how to administer the contract and develop best practices on being successful in a competitive market. It would be useful to learn more about the linkage among training, federal contracts, and business performance.
  - b. The study did not attempt to ascertain relationships between specific courses and success at obtaining federal contracts. To close this knowledge gap, the research team recommends that the SBA consider additional analyses of the relationship between specific training courses and obtaining federal contracts.
  - c. Lastly, the evaluation team recommends conducting additional research to better understand the relationship between business characteristics of 8(a) businesses and their decision to attend 7(j) training as well as which courses they take. The analysis performed in the study was exploratory and only looked at a single

cohort of businesses in phase 1 of the 8(a) program. Further research will allow the SBA to differentially market the 7(j) online training program to 8(a) businesses based on their characteristics and provide tailored recommendations on which courses they should take.

## References

- 13 CFR § 124.509 (1998, 2009, 2011).
- Brown, T. C., & Hanlon, D. (2016). Behavior Criteria for Grounding Entrepreneurship Education and Training Programs: A Validation Study. *Journal of Small Business Management*, 54(2), 399-419.
- Chiaburu, D. S., & Tekleab, A. G. (2005). Individual and contextual influences on multiple dimensions of training effectiveness. *Journal of European Industrial Training*, 29(8), 604-626.
- Clark, M., & Moutray, C. (2004). The future of small businesses in the U.S. federal government marketplace. *Journal of Public Procurement*, 4(3), 450-470.
- Derell-Murphy, F. (2017). *Strategies for Small Businesses to Win Federal Contracts*. Business Commons. Retrieved from Walden University: <https://scholarworks.waldenu.edu/dissertations/4658/>
- Enchautegui, M., Fix, M., Loprest, P., Von Der Lippe, S., & Wissoker, D. (1997). *Do Minority-Owned Businesses Get a Fair Share of Government Contracts?* Retrieved from The Urban Institute: <http://webarchive.urban.org/publications/307416.html>
- Hyochang, L. S.-G. (2007). Validating E-learning factors affecting training effectiveness. *International Journal of Information Management*, 27(1), 22-35.
- Lim, H., Lee, S.-G., & Nam, K. (2007). Validating E-learning factors affecting training effectiveness. *International Journal of Information Management: The Journal for Information Professionals*, 22-35.
- Loader, K. (2011). Are public sector procurement models and practices hindering small and medium suppliers? *Public Money & Management*, 31(4), 287-294. doi:10.1080/09540962.2011.586242.
- Loader, K. (2013, January 1). Is public procurement a successful small business support policy? A review of the evidence. *Environment and Planning C: Politics and Space*, 31(1), 39-55. doi:10.1068/c1213b
- Lyons, E., & Zhang, L. (2017). The Impact of Entrepreneurship Programs on Minorities. *American Economic Review*, 107(5), 303-307. doi:10.1257/aer.p20171008
- Martin, B. C., & al, e. (2013). Examining the formation of human capital in entrepreneurship: a meta-analysis of entrepreneurship education outcomes. *Journal of Business Venturing*, 28, 211-224.
- Martin, W., Wech, B., Sandefur, J., & Pan, R. (2006). African American Small Business Owner's Attitudes Toward Business Training. *Journal of Small Business Management*, 44(4), 577-591.
- Mick, T., & Greene, P. (2004). Minority and Women Entrepreneurs Contracting with the Federal Government. *Journal of Small Business Strategy*, 15(1), 33-45.



- Rasheed, H. (2002). Capital Access Barriers to Public Procurement Performance: The Moderating Effects of Ethnicity, Gender, and Education. *Journal of Developmental Entrepreneurship*, 9.
- Sun, P.-C., Tsai, R. J., Finger, G., Chen, Y.-Y., & Yeh, D. (2008). What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers and Education*, 50(4), 1183-1202.
- Swan, K. (2003). Learning effectiveness: what the research tells us. (J. Bourne, & J. Moore, Eds.) *Elements of Quality Online Education, Practice and Direction*, 13-45.
- Tallent-Runnels, M. K., Thomas, J. A., Lan, W. Y., Cooper, S., Ahern, T. C., Shaw, S. M., & Liu, X. (2006). Teaching Courses Online: A Review of the Research. *Review of Educational Research*, 76(1), 93-135.
- Wang, S. K., & Hsu, H. Y. (2008). Use of the webinar tool (Elluminate) to support training: The effects of webinar-learning implementation from student-trainers' perspective. *Journal of Interactive Online Learning*, 7(3), 175-194.

## Appendix A: Descriptive Statistics of the 8(a) and 7(j) Programs

Table 4: Status of 8(a) participation as of September 2018

8(a) cohort approval year	Number of businesses approved	Percent complete (includes early grads)	Average number of years to graduation	Percent withdrew/ terminated/ suspended	Average number of years to program end	Percent active	Average number of years active
2006	906	60.48	8.97	39.51	4.93	n/a	n/a
2007	688	61.49	8.97	38.51	5.24	n/a	n/a
2008	654	67.58	8.97	32.42	5.10	n/a	n/a
2009	802	58.61	8.59	41.39	5.82	n/a	n/a
2010	734	00.14	1	29.70	3.97	70.16	8.50
2011	630	00.16	7.29	19.84	4.41	80.00	7.48
2012	610	00.16	6.70	17.22	3.87	82.62	6.51
2013	421	00.00	--	7.37	3.51	92.64	5.51
2014	391	00.26	4.54	4.60	3.05	95.14	4.51
2015	570	00.00	--	1.93	2.45	98.07	3.42
2016	916	00.00	--	1.86	1.70	98.14	2.47
2017	556	00.00	--	0.36	1.23	99.64	1.54
<b>Total</b>	7,878	23.96	8.87	21.50	4.85	54.54	4.71

**Table 5: Training attendance during FY14-FY17 for businesses in the 8(a) program**

<b>Participant year in 8(a) program</b>	<b>Participants in cohorts FY06-FY17 active<sup>11</sup> in 8(a) program year<sup>12</sup></b>	<b>Number of active 8(a) businesses during FY14-FY17<sup>13</sup></b>	<b>Number of 8(a) businesses taking online training courses<sup>14</sup></b>	<b>Percent in 1 or more training courses</b>	<b>Average number of training courses per 8(a) participant</b>
<b>Year 1</b>	7,784	2,433	337	13.85	4.40
<b>Year 2</b>	7,157	2,288	390	17.05	4.79
<b>Year 3</b>	6,076	1,949	244	12.52	3.96
<b>Year 4</b>	5,264	1,931	186	9.63	3.83
<b>Year 5</b>	4,655	2,104	158	7.51	3.78
<b>Year 6</b>	4,052	2,273	153	6.73	3.76
<b>Year 7</b>	3,343	2,186	140	6.40	3.82
<b>Year 8</b>	2,632	2,045	129	6.31	4.14
<b>Year 9</b>	1,847	1,847	96	5.20	3.85
<b>Total</b>	42,809	19,061	1,833	9.62	4.17
<b>Overall</b>	7,784	6,999	1,382	19.75	n/a

<sup>11</sup> Businesses that have not been suspended or withdrawn from the 8(a) program are defined as active.

<sup>12</sup> Not all businesses approved into the 8(a) program in FY06-FY07 actively participated in the program. As a result, the number of businesses in cohorts FY06-FY17 that were active in 8(a) program year does not equal the number businesses approved.

<sup>13</sup> 7(j) training data is available for FY14-FY17 and thus does not include all years for every cohort in the 8(a) program. For example, year 1 training data are available for participants in cohorts FY14-FY17 whereas year 9 training data are available for participants in cohorts FY06-FY09. However, each participant year represents 4 cohorts.

<sup>14</sup> Stover provided 16,737 attendees (including duplicates if the attendee or business went to multiple trainings). Prior to matching, 35 businesses with no address were removed. 358 attendees listed as “SBA,” “SBDC” or “PTAC” and 2,387 attendees marked as “not current 8(a).” After collapsing attendees so each business with training is represented only once, there are 2,967 business attendees. About 49 percent of these businesses matched to an 8(a) business in the portfolio. The research team did not use the files from Stover to determine which participants are 8(a) participants because the 8(a)-participant field is missing for 57 percent of businesses. The team assumed the vast majority of non-matches are not 8(a) participants because it used fuzzy matching techniques based on business name, location, and email address, along with manual review. As multiple individuals representing the same business attended 7(j) online training courses, training attendance in this table and the entire study is grouped at the businesses level.

Table 6: Training topic(s) attended during FY14-FY17 for businesses in phase 1 of the 8(a) program

Topic (listed in order recommended by Stover) by percent unless noted		Phase 1			
	Overall	Year 1	Year 2	Year 3	Year 4
<i>Marketing topics</i>					
Marketing to the Government Buyer	30.17	35.01	36.67	29.51	25.27
Using E-Commerce to Generate Federal Business Opportunities	10.09	12.17	12.56	11.48	5.91
Capture Management	26.35	26.71	27.18	24.59	27.42
Developing and Managing Contractor Teams	23.02	25.22	28.21	28.28	16.13
Integrating Exporting into Market Development	1.31	1.19	2.31	0.41	0.00
<i>Contracting topics</i>					
Understanding RFPs	30.71	35.91	33.85	28.69	25.81
Federal Contracting Basics	26.90	29.38	30.77	25.00	26.88
Developing Technical and Past Performance	29.62	28.78	31.03	28.28	35.48
Developing Pricing and Cost Proposals	32.79	32.34	38.97	29.92	32.26
Government Contract Negotiations	23.40	27.00	25.38	20.49	18.28
Managing and Administering Government Contracts	27.22	26.71	29.74	27.87	25.27
Government Contracting Vehicles	17.79	21.66	20.26	15.16	19.89
Audits and Accounting Systems	26.19	29.97	28.46	25.82	23.66
<i>Construction topics</i>					
Preparing Bids for Construction Contracting	10.04	8.31	10.51	9.84	8.60
Introduction to Construction Project Management	13.26	10.39	14.87	13.52	10.22
Special Topics for Construction Management	8.35	7.14	10.51	6.56	7.53
<i>Other related topics</i>					
Facilities Clearances	13.75	12.76	15.90	14.34	14.52
How to Qualify for the GSA Schedule	16.86	18.69	22.82	14.75	12.90
Strategic Planning for Small Business	17.40	21.07	15.90	15.16	12.90
<i>Number of 8(a) participants with 1 or more training courses</i>	1,833	337	390	244	186

Table 7: Training topic(s) attended during FY14-FY17 for businesses in phase 2 of the 8(a) program

Topic (listed in order recommended by Stover) by percent unless noted			Phase 2		
	Year 5	Year 6	Year 7	Year 8	Year 9
<i>Marketing topics</i>					
Marketing to the Government Buyer	20.89	<b>30.07</b>	25.00	29.46	20.83
Using E-Commerce to Generate Federal Business Opportunities	6.33	8.50	7.14	12.40	7.29
Capture Management	<b>30.38</b>	26.80	20.71	24.81	27.08
Developing and Managing Contractor Teams	22.15	16.34	17.86	22.48	14.58
Integrating Exporting into Market Development	0.63	1.31	1.43	2.33	2.08
<i>Contracting topics</i>					
Understanding RFPs	28.48	24.84	29.29	28.68	32.29
Federal Contracting Basics	20.89	24.84	23.57	24.81	28.13
Developing Technical and Past Performance	27.22	24.84	<b>30.71</b>	<b>29.46</b>	<b>29.17</b>
Developing Pricing and Cost Proposals	27.85	28.76	<b>31.43</b>	<b>34.11</b>	<b>32.29</b>
Government Contract Negotiations	21.52	23.53	23.57	24.81	20.83
Managing and Administering Government Contracts	24.05	26.14	<b>30.71</b>	26.36	23.96
Government Contracting Vehicles	14.56	14.38	20.00	13.18	10.42
Audits and Accounting Systems	22.78	22.88	29.29	23.26	19.79
<i>Construction topics</i>					
Preparing Bids for Construction Contracting	10.13	9.80	12.14	11.63	12.50
Introduction to Construction Project Management	12.66	16.99	12.86	18.60	10.42
Special Topics for Construction Management	7.59	5.88	7.14	11.63	12.50
<i>Other related topics</i>					
Facilities Clearances	15.19	11.76	14.29	10.08	9.38
How to Qualify for the GSA Schedule	20.89	13.73	6.43	14.73	15.63
Strategic Planning for Small Business	17.72	17.65	17.14	20.16	19.79
<i>Number of 8(a) participants with 1 or more training courses</i>	<b>158</b>	<b>153</b>	<b>140</b>	<b>129</b>	<b>96</b>

**Table 8: Owner-level characteristics for businesses in the treatment group (For cohorts 14-17)**

<b>Participant year in 8(a) program</b>	<b>Number of 8(a) participants active during FY14-FY17</b>	<b>Race of the business owner (Category   Percent)</b>		<b>Gender of the business owner (Category   Percent)</b>	
<b>Year 1</b>	636	Asian	20.91	Female	38.21
		Black	38.84	Male	56.60
		Other	14.94	Missing	5.19
		Hispanic	20.44		
		Missing	4.87		
<b>Year 2</b>	548	Asian	19.89	Female	36.50
		Black	40.33	Male	57.85
		Other	13.50	Missing	5.66
		Hispanic	20.99		
		Missing	5.29		
<b>Year 3</b>	309	Asian	22.98	Female	34.95
		Black	35.92	Male	58.90
		Other	12.62	Missing	6.15
		Hispanic	22.65		
		Missing	5.83		
<b>Year 4</b>	141	Asian	26.24	Female	38.30
		Black	34.03	Male	55.32
		Other	13.48	Missing	6.38
		Hispanic	19.86		
		Missing	6.38		
<b>Overall</b>	1,634	Asian	21.42	Female	37.03
		Black	38.37	Male	57.34
		Other	13.89	Missing	5.63
		Hispanic	20.99		
		Missing	5.32		

**Table 9: Owner-level characteristics for businesses not in the treatment group (For cohorts 14-17)**

Participant year in 8(a) program	Number of 8(a) participants active during FY14-FY17	Race of the business owner (Category   Percent)		Gender of the business owner (Category   Percent)	
Year 1	1,797	Asian	20.14		
		Black	32.89	Female	29.38
		Other	12.13	Male	56.71
		Hispanic	20.70	Missing	13.91
		Missing	14.13		
Year 2	1,322	Asian	20.73		
		Black	32.22	Female	29.05
		Other	12.41	Male	57.72
		Hispanic	21.26	Missing	13.24
		Missing	13.39		
Year 3	642	Asian	20.40		
		Black	30.06	Female	25.86
		Other	12.77	Male	60.12
		Hispanic	22.43	Missing	14.02
		Missing	14.33		
Year 4	239	Asian	21.34		
		Black	29.29	Female	21.34
		Other	14.23	Male	64.85
		Hispanic	21.76	Missing	13.81
		Missing	13.39		
Overall	4,000	Asian	20.45		
		Black	32.00	Female	28.23
		Other	12.45	Male	58.07
		Hispanic	21.22	Missing	13.70
		Missing	13.88		

**Table 10: Business-level characteristics for businesses in the treatment group (For cohorts 14-17)**

<b>Year in 8(a) program</b>	<b>Number of 8(a) participants active during FY14-FY17</b>	<b>Business age (Category   Percent)</b>		<b>Business Industry (Category   Percent)</b>		<b>Business located in DC, MD, or VA (Category   Percent)</b>		<b>Average years in the program</b>
<b>Year 1</b>	636	< 6 years 6-10 years > 10 years	40.88 35.69 23.43	Manufacturing/ Construction Professional Services Other	25.94 51.10 22.96	Yes No	22.80 77.20	3.07
<b>Year 2</b>	548	< 6 years 6-10 years > 10 years	29.93 41.24 28.83	Manufacturing/ Construction Professional Services Other	26.46 51.09 22.45	Yes No	23.54 76.46	3.30
<b>Year 3</b>	309	< 6 years 6-10 years > 10 years	19.42 46.93 33.66	Manufacturing/ Construction Professional Services Other	27.83 48.87 23.30	Yes No	24.60 75.40	3.91
<b>Year 4</b>	141	< 6 years 6-10 years > 10 years	7.80 46.10 46.10	Manufacturing/ Construction Professional Services Other	26.95 52.48 20.57	Yes No	25.53 74.47	4.52
<b>Overall</b>	1,634	< 6 years 6-10 years > 10 years	30.29 40.58 29.13	Manufacturing/ Construction Professional Services Other	26.56 50.80 22.64	Yes No	23.62 76.38	3.43



**Table 11: Business-level characteristics for businesses not in the treatment group (For cohorts 14-17)**

<b>Year in 8(a) program</b>	<b>Number of 8(a) participants active during FY14-FY17</b>	<b>Business age (Category   Percent)</b>		<b>Business Industry (Category   Percent)</b>		<b>Business located in DC, MD, or VA (Category   Percent)</b>		<b>Average years in the program</b>
<b>Year 1</b>	1,797	< 6 years 6-10 years > 10 years	41.96 33.44 24.60	Manufacturing/ Construction Professional Services Other	26.21 48.08 25.71	Yes No	33.83 66.17	2.69
<b>Year 2</b>	1,322	< 6 years 6-10 years > 10 years	31.85 38.96 29.20	Manufacturing/ Construction Professional Services Other	26.63 47.28 26.10	Yes No	35.33 64.67	3.11
<b>Year 3</b>	642	< 6 years 6-10 years > 10 years	21.96 44.86 33.18	Manufacturing/ Construction Professional Services Other	27.10 48.91 23.99	Yes No	36.14 63.86	3.81
<b>Year 4</b>	239	< 6 years 6-10 years > 10 years	10.88 45.61 41.51	Manufacturing/ Construction Professional Services Other	28.45 43.93 27.62	Yes No	30.54 69.46	4.48
<b>Overall</b>	4,000	< 6 years 6-10 years > 10 years	33.55 37.82 28.63	Manufacturing/ Construction Professional Services Other	26.63 47.70 25.67	Yes No	34.50 65.50	3.12

## Appendix B: Research Question 1 Summary Statistics & Results

**Table 12: Summary statistics for the analysis dataset of FY2014 businesses in their first year in the 8(a) program prepared for cluster and decision analysis to identify differences in characteristics of businesses that attend 7(j) training from those who do not**

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Average annual revenue for the past three years in dollars</i>	1,130,498.00	5,567,609.00	0.00	234,000,000.00
<i>Age of the business in years</i>	8.02	6.10	1.00	65.00
<i>Primary industry is Manufacturing or Construction</i>	0.26	0.44	0.00	1.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	0.49	0.50	0.00	1.00
<i>Primary industry is other</i>	0.25	0.43	0.00	1.00
<i>Veteran-Owned Small Business</i>	0.16	0.37	0.00	1.00
<i>Women-Owned Small Business</i>	0.33	0.47	0.00	1.00
<i>8(a) business with joint venture</i>	0.00	0.00	0.00	0.00
<i>HUBZone business</i>	0.08	0.27	0.00	1.00
<i>Minority-Owned Small Business</i>	0.87	0.34	0.00	1.00
<i>Located in the Washington, D.C. MSA</i>	0.31	0.46	0.00	1.00
<i>Had a federal contract prior to joining the 8(a) program</i>	0.25	0.44	0.00	1.00
<i>Average number of employees</i>	8.64	15.37	0.00	330.00
<i>Attended at least one 7(j) online training course</i>	0.26	0.44	0.00	1.00
<b>Number of observations</b>	<b>2400</b>			

**Table 13: Relative importance of variables or predictors in the random forest model to identify differences in characteristics of businesses that attend 7(j) training from those who do not**

<b>Variable</b>	<b>Predictive power in percent</b>
<i>Average annual revenue</i>	36
<i>Business age</i>	23
<i>Average number of employees</i>	21
<i>DC area</i>	3
<i>Women-Owned Small Business</i>	3
<i>Contract prior to 8(a) program</i>	3
<i>Veteran-Owned Small Business</i>	3
<i>Minority-Owned Small Business</i>	2
<i>HUBZone</i>	2
<i>Professional, Scientific, and Technical Services</i>	2
<i>Other industry</i>	2
<i>Manufacturing or Construction</i>	1
<i>8(a) joint venture</i>	0

**Table 14: Normalized confusion matrix presenting the results of the random forest model to identify differences in characteristics of businesses that attend 7(j) training from those who do not**

	<b>Predicted attendance of 7(j) training in percent</b>		
		<i>No training</i>	<i>Training</i>
<b>Actual attendance of 7(j) training in percent</b>	<i>No training</i>	<b>93.47</b>	6.53
	<i>Training</i>	91.46	<b>8.54</b>
<b>Overall accuracy in percent</b>	<b>70</b>		

**Table 15: Normalized confusion matrix presenting the results of the cluster analysis to identify differences in characteristics of businesses that attend 7(j) training from those who do not**

	<b>Predicted attendance of 7(j) training in percent</b>		
		<i>No training</i>	<i>Training</i>
<b>Actual attendance of 7(j) training in percent</b>	<i>No training</i>	<b>48.25</b>	51.75
	<i>Training</i>	50.79	<b>49.21</b>
<b>Overall accuracy in percent</b>	<b>49</b>		

**Table 16: Summary statistics of the analysis dataset of FY2014 businesses in their first four years in the 8(a) program developed to identify their course taking pattern**

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Average annual revenue for the past three years in dollars</i>	1,596,935.00	2,132,084.00	1.00	14,200,000.00
<i>Age of the business in years</i>	10.02	5.99	1.00	31.00
<i>Primary industry is Manufacturing or Construction</i>	0.27	0.44	0.00	1.00
<i>Primary industry is Professional, Scientific, and technical services</i>	0.52	0.50	0.00	1.00
<i>Primary industry is other</i>	0.21	0.41	0.00	1.00
<i>Veteran-Owned Small Business</i>	0.22	0.41	0.00	1.00
<i>Women-Owned Small Business</i>	0.38	0.49	0.00	1.00
<i>8(a) business with joint venture</i>	0.00	0.00	0.00	0.00
<i>HUBZone business</i>	0.10	0.30	0.00	1.00
<i>Minority-Owned Small Business</i>	0.86	0.34	0.00	1.00
<i>Located in the Washington, D.C. MSA</i>	0.25	0.44	0.00	1.00
<i>Average number of employees</i>	12.74	20.95	1.00	165.00
<i>Took at least one course on marketing topics</i>	0.47	0.50	0.00	1.00
<i>Took at least one course on contracting topics</i>	0.66	0.47	0.00	1.00
<i>Took at least one course on construction topics</i>	0.18	0.38	0.00	1.00
<i>Took at least one course on other topics</i>	0.36	0.48	0.00	1.00
<i>Audits and Accounting Systems</i>	0.12	0.32	0.00	1.00
<i>Capture Management</i>	0.10	0.29	0.00	1.00
<i>Preparing Bids for Construction Contracting</i>	0.04	0.20	0.00	1.00
<i>Developing the Cost Proposal</i>	0.14	0.35	0.00	1.00
<i>Developing Technical and Past Performance Proposals</i>	0.11	0.32	0.00	1.00
<i>Developing and Managing Contractor Teams</i>	0.11	0.31	0.00	1.00
<i>Facilities Clearances</i>	0.06	0.24	0.00	1.00
<i>Federal Contracting Basics</i>	0.12	0.33	0.00	1.00
<i>Government Contract Negotiations</i>	0.11	0.31	0.00	1.00
<i>Government Contract Types</i>	0.10	0.30	0.00	1.00

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>How to Qualify for the GSA Schedule</i>	0.07	0.25	0.00	1.00
<i>Integrating Exporting into Market Development</i>	0.01	0.08	0.00	1.00
<i>Introduction to Managing Government Construction Projects</i>	0.04	0.20	0.00	1.00
<i>Managing and Administrating Government Contracts</i>	0.11	0.31	0.00	1.00
<i>Marketing to the Government Buyer</i>	0.12	0.33	0.00	1.00
<i>Special topics on construction management</i>	0.03	0.17	0.00	1.00
<i>Strategic Planning for Small Business</i>	0.07	0.26	0.00	1.00
<i>Understanding Requests for Proposal (RFP)</i>	0.13	0.34	0.00	1.00
<i>Using E-Commerce to Generate Federal Business Opportunities</i>	0.05	0.21	0.00	1.00
<i>Year in the 8(a) program</i>	2.49	1.12	1.00	4.00
<i>Had a federal contract prior to joining the 8(a) program</i>	0.09	0.29	0.00	1.00
<i>Attended at least one 7(j) online training course</i>	1.00	0.00	1.00	1.00
<b>Number of observations</b>	<b>568</b>			

**Table 17: Summary statistics of the cluster composed of FY2014 business in their first four years in the 8(a) program based on their course taking pattern of marketing and construction course**

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Age of the business in years</i>	9.77	5.25	2.00	24.00
<i>Year in the 8(a) program</i>	2.51	1.02	1.00	4.00
<i>Located in the Washington, D.C. MSA</i>	0.28	0.45	0.00	1.00
<i>Number of employees</i>	12.18	16.66	1.00	89.00
<i>Average annual revenue for the past three years in dollars</i>	1,730,246.00	2,057,579.00	1.00	9,000,000.00
<i>Minority-Owned Small Business</i>	0.90	0.30	0.00	1.00
<i>Veteran-Owned Small Business</i>	0.27	0.44	0.00	1.00
<i>Women-Owned Small Business</i>	0.36	0.48	0.00	1.00
<i>8(a) business with joint venture</i>	0.00	0.00	0.00	0.00
<i>HUBZone business</i>	0.07	0.26	0.00	1.00
<i>Primary industry is Manufacturing or Construction</i>	0.23	0.42	0.00	1.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	0.63	0.49	0.00	1.00
<i>Primary industry is other</i>	0.14	0.35	0.00	1.00
<b>Number of observations</b>				<b>83</b>

**Table 18: Summary statistics of the cluster composed of FY2014 business in their first four years in the 8(a) program based on their lack of clear course taking pattern**

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Age of the business in years</i>	10.06	6.12	1.00	31.00
<i>Year in the 8(a) program</i>	2.49	1.13	1.00	4.00
<i>Located in the Washington, D.C. MSA</i>	0.25	0.43	0.00	1.00
<i>Number of employees</i>	12.84	21.61	1.00	165.00
<i>Average annual revenue for the past three years in dollars</i>	1,574,121.00	2,145,808.00	1.00	14,207,000.00
<i>Minority-Owned Small Business</i>	0.86	0.35	0.00	1.00
<i>Veteran-Owned Small Business</i>	0.21	0.41	0.00	1.00
<i>Women-Owned Small Business</i>	0.38	0.49	0.00	1.00
<i>8(a) business with joint venture</i>	0.00	0.00	0.00	0.00
<i>HUBZone business</i>	0.10	0.30	0.00	1.00
<i>Primary industry is Manufacturing or Construction</i>	0.28	0.45	0.00	1.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	0.50	0.50	0.00	1.00
<i>Primary industry is other</i>	0.22	0.41	0.00	1.00
<b>Number of observations</b>	<b>485</b>			



**Table 19: Summary statistics of the analysis dataset of FY2014 businesses in their first year in the 8(a) program developed to identify their course taking pattern**

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Average annual revenue for the past three years in dollars</i>	1,123,032.00	1,724,806.00	1.00	10,100,000.00
<i>Age of the business in years</i>	8.59	5.94	1.00	28.00
<i>Primary industry is Manufacturing or Construction</i>	0.27	0.45	0.00	1.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	0.51	0.50	0.00	1.00
<i>Primary industry is other</i>	0.21	0.41	0.00	1.00
<i>Veteran-Owned Small Business</i>	0.21	0.41	0.00	1.00
<i>Women-Owned Small Business</i>	0.37	0.49	0.00	1.00
<i>8(a) business with joint venture</i>	0.00	0.00	0.00	0.00
<i>HUBZone business</i>	0.04	0.18	0.00	1.00
<i>Minority-Owned Small Business</i>	0.86	0.35	0.00	1.00
<i>Located in the Washington, D.C. MSA</i>	0.25	0.43	0.00	1.00
<i>Average number of employees</i>	10.36	18.77	1.00	150.00
<i>Took at least one course on marketing topics</i>	0.19	0.39	0.00	1.00
<i>Took at least one course on contracting topics</i>	0.32	0.47	0.00	1.00
<i>Took at least one course on construction topics</i>	0.07	0.26	0.00	1.00
<i>Took at least one course on other topics</i>	0.15	0.36	0.00	1.00
<i>Audits and Accounting Systems</i>	0.15	0.36	0.00	1.00
<i>Capture Management</i>	0.08	0.28	0.00	1.00
<i>Preparing Bids for Construction Contracting</i>	0.04	0.18	0.00	1.00
<i>Developing the Cost Proposal</i>	0.13	0.33	0.00	1.00
<i>Developing Technical and Past Performance Proposals</i>	0.11	0.31	0.00	1.00
<i>Developing and Managing Contractor Teams</i>	0.09	0.29	0.00	1.00
<i>Facilities Clearances</i>	0.06	0.23	0.00	1.00
<i>Federal Contracting Basics</i>	0.11	0.31	0.00	1.00
<i>Federal Contracting Basics</i>	0.11	0.32	0.00	1.00
<i>Government Contract Types</i>	0.06	0.23	0.00	1.00

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>How to Qualify for the GSA Schedule</i>	0.05	0.22	0.00	1.00
<i>Integrating Exporting into Market Development</i>	0.00	0.00	0.00	0.00
<i>Introduction to Managing Government Construction Projects</i>	0.06	0.23	0.00	1.00
<i>Managing and Administrating Government Contracts</i>	0.09	0.29	0.00	1.00
<i>Marketing to the Government Buyer</i>	0.12	0.33	0.00	1.00
<i>Special topics on construction management</i>	0.01	0.12	0.00	1.00
<i>Strategic Planning for Small Business</i>	0.08	0.27	0.00	1.00
<i>Understanding Requests for Proposal (RFP)</i>	0.18	0.38	0.00	1.00
<i>Using E-Commerce to Generate Federal Business Opportunities</i>	0.05	0.22	0.00	1.00
<i>Year in the 8(a) program</i>	1.00	0.00	1.00	1.00
<i>Had a federal contract prior to joining the 8(a) program</i>	0.36	0.48	0.00	1.00
<i>Attended at least one 7(j) online training course</i>	1.00	0.00	1.00	1.00
<b>Number of observations</b>	<b>142</b>			

**Table 20: Summary statistics of the cluster composed of FY2014 business in their first fours in the 8(a) program based on their course taking pattern of marketing and contracting courses**

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Age of the business in years</i>	7.38	3.59	3.00	15.00
<i>Year in the 8(a) program</i>	1.00	0.00	1.00	1.00
<i>Located in the Washington, D.C. MSA</i>	0.54	0.52	0.00	1.00
<i>Had a contract prior to joining the 8(a) program</i>	0.38	0.51	0.00	1.00
<i>Number of employees</i>	5.46	4.54	2.00	15.00
<i>Average annual revenue for the past three years in dollars</i>	578,841.69	587,013.55	100,000.00	1,700,000.00
<i>Minority-Owned Small Business</i>	1.00	0.00	1.00	1.00
<i>Veteran-Owned Small Business</i>	0.38	0.51	0.00	1.00
<i>Women-Owned Small Business</i>	0.38	0.51	0.00	1.00
<i>8(a) business with joint venture</i>	0.00	0.00	0.00	0.00
<i>HUBZone business</i>	0.00	0.00	0.00	0.00
<i>Primary industry is Manufacturing or Construction</i>	0.00	0.00	0.00	0.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	0.62	0.51	0.00	1.00
<i>Primary industry is other</i>	0.38	0.51	0.00	1.00
<b>Number of observations</b>	<b>13</b>			

**Table 21: Summary statistics of the cluster composed of FY2014 business in their first four years in the 8(a) program based on their lack of clear course taking pattern of construction courses**

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Age of the business in years</i>	8.33	4.59	4.00	16.00
<i>Year in the 8(a) program</i>	1.00	0.00	1.00	1.00
<i>Located in the Washington, D.C. MSA</i>	0.17	0.41	0.00	1.00
<i>Had a contract prior to joining the 8(a) program</i>	0.50	0.55	0.00	1.00
<i>Number of employees</i>	5.17	5.00	1.00	15.00
<i>Average annual revenue for the past three years in dollars</i>	1,918,494.00	3,619,200.00	104,709.00	9,276,253.00
<i>Minority-Owned Small Business</i>	0.83	0.41	0.00	1.00
<i>Veteran-Owned Small Business</i>	0.33	0.52	0.00	1.00
<i>Women-Owned Small Business</i>	0.00	0.00	0.00	0.00
<i>8(a) business with joint venture</i>	0.00	0.00	0.00	0.00
<i>HUBZone business</i>	0.17	0.41	0.00	1.00
<i>Primary industry is Manufacturing or Construction</i>	0.83	0.41	0.00	1.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	0.00	0.00	0.00	0.00
<i>Primary industry is other</i>	0.17	0.41	0.00	1.00
<b>Number of observations</b>	<b>6</b>			

**Table 22: Summary statistics of the cluster composed of FY2014 business in their first year in the 8(a) program based on their lack of clear course taking pattern**

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Age of the business in years</i>	8.87	6.28	1.00	28.00
<i>Year in the 8(a) program</i>	1.00	0.00	1.00	1.00
<i>Located in the Washington, D.C. MSA</i>	0.23	0.42	0.00	1.00
<i>Had a contract prior to joining the 8(a) program</i>	0.37	0.48	0.00	1.00
<i>Number of employees</i>	12.08	21.04	1.00	150.00
<i>Average annual revenue for the past three years in dollars</i>	1,211,445.00	1,753,383.00	1.00	10,148,671.00
<i>Minority-Owned Small Business</i>	0.83	0.37	0.00	1.00
<i>Veteran-Owned Small Business</i>	0.20	0.40	0.00	1.00
<i>Women-Owned Small Business</i>	0.40	0.49	0.00	1.00
<i>8(a) business with joint venture</i>	0.00	0.00	0.00	0.00
<i>HUBZone business</i>	0.04	0.19	0.00	1.00
<i>Primary industry is Manufacturing or Construction</i>	0.28	0.45	0.00	1.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	0.52	0.50	0.00	1.00
<i>Primary industry is other</i>	0.19	0.40	0.00	1.00
<b>Number of observations</b>	<b>109</b>			

**Table 23: Summary statistics of the cluster composed of FY2014 business in their first year in the 8(a) program based on their course taking pattern of contracting courses**

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Age of the business in years</i>	7.64	5.69	2.00	22.00
<i>Year in the 8(a) program</i>	1.00	0.00	1.00	1.00
<i>Located in the Washington, D.C. MSA</i>	0.14	0.36	0.00	1.00
<i>Had a contract prior to joining the 8(a) program</i>	0.21	0.43	0.00	1.00
<i>Number of employees</i>	3.71	2.40	1.00	8.00
<i>Average annual revenue for the past three years in dollars</i>	599,075.00	648,595.50	1.00	2,157,656.00
<i>Minority-Owned Small Business</i>	0.93	0.27	0.00	1.00
<i>Veteran-Owned Small Business</i>	0.07	0.27	0.00	1.00
<i>Women-Owned Small Business</i>	0.29	0.47	0.00	1.00
<i>8(a) business with joint venture</i>	0.00	0.00	0.00	0.00
<i>HUBZone business</i>	0.00	0.00	0.00	0.00
<i>Primary industry is Manufacturing or Construction</i>	0.21	0.43	0.00	1.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	0.57	0.51	0.00	1.00
<i>Primary industry is other</i>	0.21	0.43	0.00	1.00
<b>Number of observations</b>	<b>14</b>			

## Appendix C: Research Question 2 Summary Statistics & Results

**Table 24: Summary statistics of businesses from the FY2014-FY2017 cohort during their first year in the 8(a) program developed for conducting CEM matching to create the analytical dataset**

Variable	No. of obs. <sup>15</sup>	Mean	Std. Dev.	Min.	Max.
<i>Age of the business in years</i>	2420	8.03	6.10	1.00	65.00
<i>Primary industry is Manufacturing or Construction</i>	2430	0.26	0.44	0.00	1.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	2430	0.49	0.50	0.00	1.00
<i>Primary industry is other</i>	2430	0.25	0.43	0.00	1.00
<i>Had a contract prior to joining the 8(a) program</i>	2430	0.25	0.43	0.00	1.00
<i>Average annual revenue for the past three years in dollars</i>	2410	1,126,512.00	5,556,441.00	0.00	234,000,000.00
<i>Number of employees</i>	2410	8.61	15.35	0.00	330.00
<i>Located in the Washington, D.C. MSA</i>	2430	0.31	0.46	0.00	1.00
<i>Attended at least one 7(j) online training course</i>	2430	0.26	0.44	0.00	1.00

<sup>15</sup> The number of observations listed in the table differ for some variables as observations with missing values were not dropped as the CEM matching allows for missing values to be treated as a valid response category in the coarsened version of the variables.

**Table 25: Summary statistics of businesses from the FY2014-FY2017 cohort during their first year in the 8(a) program developed for conducting CEM matching to create the analytical dataset that did not attend any 7(j) training**

<b>Variable</b>	<b>No. of obs.<sup>16</sup></b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Age of the business in years</i>	1,787	7.97	6.15	1.00	65.00
<i>Primary industry is Manufacturing or Construction</i>	1,794	0.26	0.44	0.00	1.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	1,794	0.48	0.50	0.00	1.00
<i>Primary industry is other</i>	1,794	0.26	0.44	0.00	1.00
<i>Had a contract prior to joining the 8(a) program</i>	1,794	0.25	0.43	0.00	1.00
<i>Average annual revenue for the past three years in dollars</i>	1,777	1,109,251.00	6,272,230.00	0.00	234,000,000.00
<i>Number of employees</i>	1,777	8.31	15.16	0.00	330.00
<i>Located in the Washington, D.C. MSA</i>	1,794	0.34	0.47	0.00	1.00

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<sup>16</sup> The number of observations listed in the table differ for some variables as observations with missing values were not dropped as the CEM matching allows for missing values to be treated as a valid response category in the coarsened version of the variables.



**Table 26: Summary statistics of businesses from the FY2014-FY2017 cohort during their first year in the 8(a) program developed for conducting CEM matching to create the analytical dataset that attend at least one 7(j) training course**

<b>Variable</b>	<b>No. of obs.<sup>17</sup></b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Age of the business in years</i>	633	8.20	5.93	1.00	59.00
<i>Primary industry is Manufacturing or Construction</i>	636	0.26	0.44	0.00	1.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	636	0.51	0.50	0.00	1.00
<i>Primary industry is other</i>	636	0.23	0.42	0.00	1.00
<i>Had a contract prior to joining the 8(a) program</i>	636	0.26	0.44	0.00	1.00
<i>Average annual revenue for the past three years in dollars</i>	633	1,174,970.00	2,669,611.00	1.00	46,800,000.00
<i>Number of employees</i>	633	9.46	15.84	0.00	150.00
<i>Located in the Washington, D.C. MSA</i>	636	0.23	0.42	0.00	1.00

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<sup>17</sup> The number of observations listed in the table differ for some variables as observations with missing values were not dropped as the CEM matching allows for missing values to be treated as a valid response category in the coarsened version of the variables.

**Table 27: Multivariate L1 distance capturing the difference between the characteristics of businesses from the FY2014-FY2017 cohort during their first year in the 8(a) program based on whether they attended 7(j) training**

<i>Multivariate L1 distance</i>	<b>0.492225</b>
<b>Number of observations</b>	<b>2430</b>

**Table 28: Univariate imbalance capturing the difference between each variable of businesses characteristics of 8(a) businesses from the FY2014-FY2017 cohort during their first year in the 8(a) program based on whether they attended 7(j) training**

<b>Coarsened variables</b>	<b>L1</b>	<b>Mean</b>	<b>Min.</b>	<b>25%</b>	<b>50%</b>	<b>75%</b>	<b>Max.</b>
<i>Age of the business in years</i>	0.095450	0.235460	0	0	1	0	-6
<i>Primary industry</i>	0.026450	-0.027440	0	0	0	-1	0
<i>Had a contract prior to joining the 8(a) program</i>	0.009470	0.009470	0	0	0	0	0
<i>Average annual revenue for the past three years in dollars</i>	0.046570	67,565.00	1	40,000	69,314	2.30E+05	1.90E+08
<i>Number of employees</i>	0.073770	1.180400	0	0	0	0	-180
<i>Located in the Washington, D.C. MSA</i>	0.112000	-0.112000	0	0	0	-1	0
<b>Number of observations</b>	<b>2430</b>						

**Table 29: Summary of CEM matching – number of total strata in the dataset and the number of matched strata**

Matching Summary	
<i>Number of strata</i>	299
<i>Number of matched strata</i>	169

**Table 30: Number of observations matched and the multivariate L1 distance capturing the difference between the characteristics of businesses from the FY2014-FY2017 cohort during their first year in the 8(a) program based on whether they attended 7(j) training after CEM matching**

	No training	Training
<i>All observations</i>	1794	636
<i>Matched observations</i>	1543	614
<i>Unmatched observations</i>	251	22
<i>Multivariate L1 distance</i>	6.18E-16	

**Table 31: Univariate imbalance capturing the difference between each variable of businesses characteristics of 8(a) businesses from the FY2014-FY2017 cohort during their first year in the 8(a) program based on whether they attended 7(j) training after CEM matching**

Coarsened variables	L1	Mean	Min.	25%	50%	75%	Max.
<i>Age of the business in years</i>	6.30E-16	5.80E-15	0	0	0	0	.
<i>Primary industry</i>	1.00E-15	2.20E-15	0	0	0	0	0
<i>Had a contract prior to joining the 8(a) program</i>	4.70E-16	-3.90E-16	0	0	0	0	0
<i>Average annual revenue for the past three years</i>	5.10E-16	-8.90E-01	0	0	0	0	0
<i>Number of employees</i>	5.30E-16	-2.20E-15	0	0	0	0	0
<i>Located in the Washington, D.C. MSA</i>	4.30E-16	-8.30E-17	0	0	0	0	0
<b>Number of observations</b>	<b>2430</b>						

**Equation 1: Detailed specification of the linear probability model to estimate the sample average treatment effect on the treated of 7(j) training for cohort FY2014-FY2017 businesses**

$$Y_i = \alpha + \beta T_i + \varepsilon_i$$

Where,

$i$  = the DUNS number of the 8(a) business;

$Y_i$  = whether the 8(a) business obtained a federal contract; and

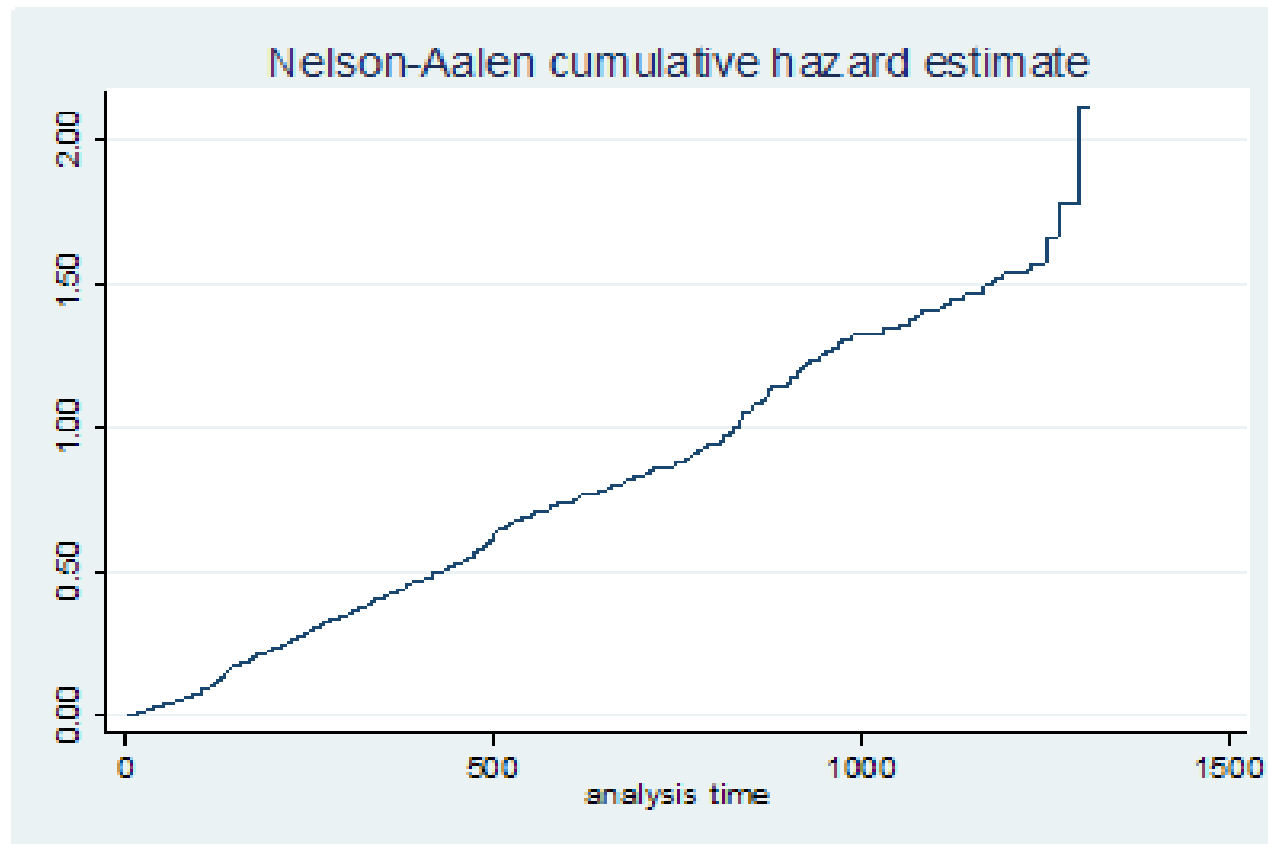
$T_i$  = whether the 8(a) business attended at least one course of the 7(j) online training program.

**Table 32: Results of the linear probability model to estimate the sample average treatment effect on the treated of 7(j) training for cohort FY2014-FY2017 businesses**

Variable	Mean.	Std. Error
<i>Attended at least one 7(j) online training course ***</i>	0.12	0.03
<b>Number of observations</b>	<b>2157</b>	

\*\*\*indicates statistical significance at the 1 percent level

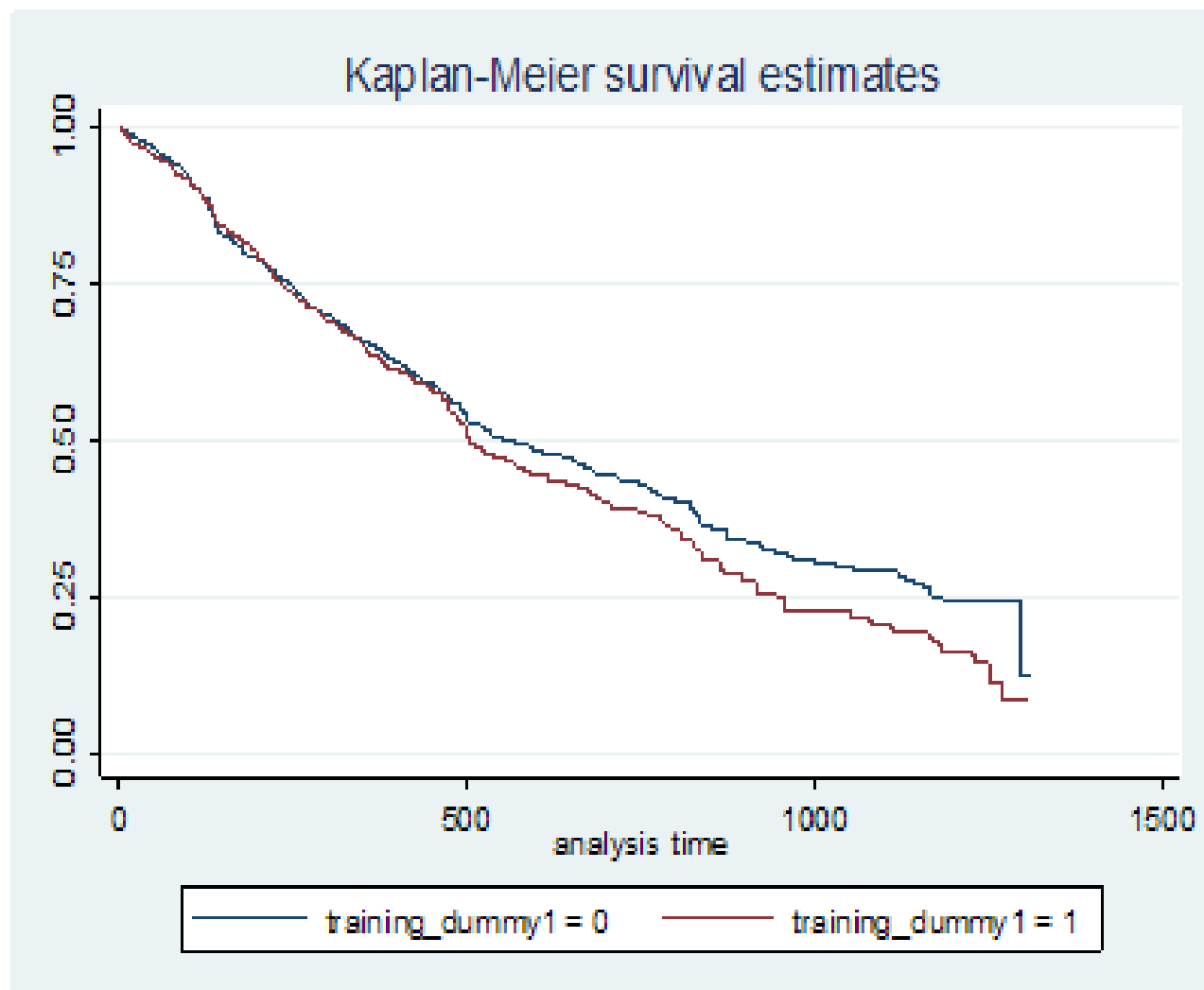
Figure 8: Nelson-Aalen cumulative hazard estimate for the time to obtain a federal contract



**Table 33: Log-rank test of equality for the predictor variable that captures whether the 8(a) business attended at least one 7(j) training**

<b>Variable</b>	<b>Events</b>	<b>Events</b>
<i>Attended at least one 7(j) online training course</i>	<i>Observed</i>	<i>Expected</i>
No	718	747.91
Yes	361	331.09
<i>Total</i>	1079	1079
<i>chi2(1)</i>		3.91
<i>Pr&gt;chi2</i>		<b>0.0479</b>

Figure 9: Kaplan-Meier survival estimates by whether the 8(a) business attended at least one 7(j) training



**Equation 2: Detailed specification of the survival analysis model on obtaining contract with the hazard ratio**

$$h_i(t) = h_i(t) \exp(\beta T_i) + \varepsilon_i$$

Where,

- $i$  = is the DUNS number of the 8(a) business;
- $T$  = is time measured in days;
- $h_i(t)$  = is the hazard function; and
- $T_i$  = whether the 8(a) business attended at least one course of the 7(j) online training program.

**Table 34: Results of the survival analysis on obtaining contract run with the hazard ratio**

Variable	Hazard Ratio	Std. Error
<i>Attended at least one 7(j) online training course **</i>	1.14	0.07
<b>Number of observations</b>	<b>2157</b>	

\*\*indicates statistical significance at the 5 percent level



**Table 35: Assessment of whether the Cox proportional hazard survival analysis model meets the assumption of proportionality**

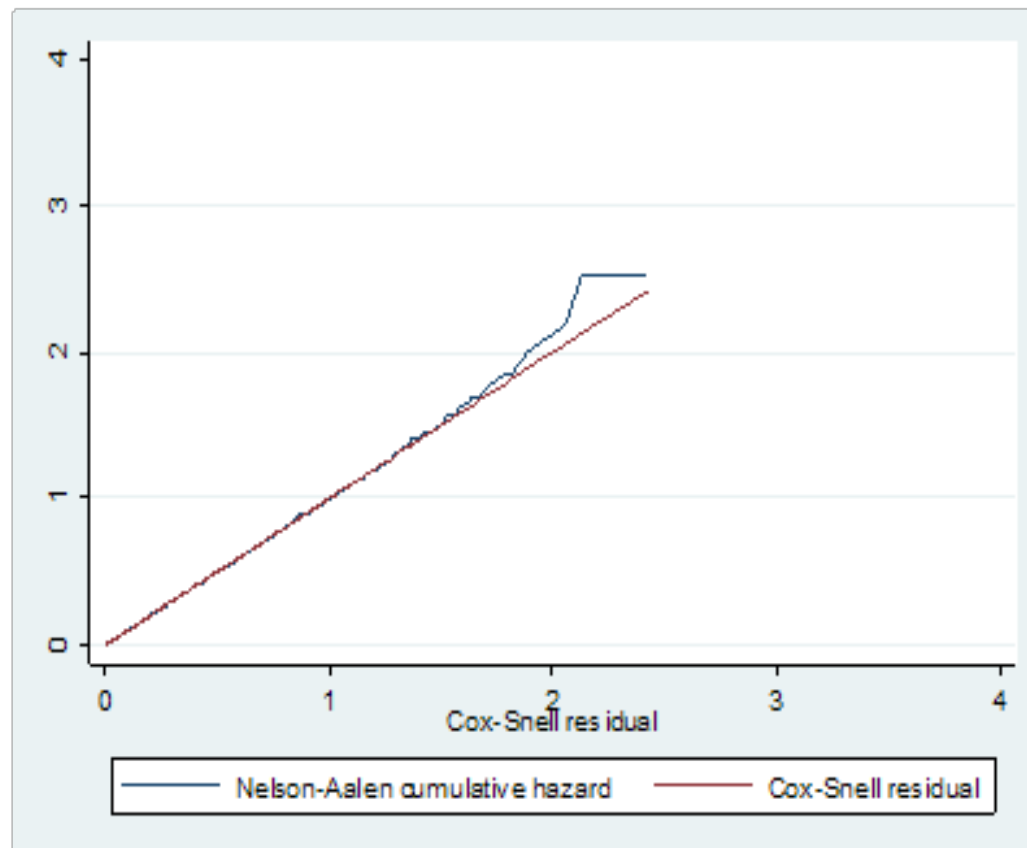
Variable	Coefficient	Std. Error.
Main		
<i>Attended at least one 7(j) online training course</i>	-0.40	0.36
TVC <sup>18</sup>		
<i>Attended at least one 7(j) online training course</i>	0.10	0.06
<b>Number of observations</b>	2157	

Note: The variable of interest, *Attended at least one 7(j) online training course*, is interacted with the natural log of time in days in TVC equation.

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<sup>18</sup> Time-Varying Covariates

Figure 10: Goodness of fit of the survival analysis model



## Appendix D: Research Question 3 Summary Statistics & Results

**Table 36: Summary statistics of the analytical dataset prepared to answer the third research question**

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<i>Non-8(a) contracts in federal portfolio</i>	0.52	0.45	0.00	4.73
<i>Is in phase 2 of the 8(a) program</i>	0.58	0.49	0.00	1.00
<i>Attended at least one 7(j) training course</i>	0.11	0.31	0.00	1.00
<i>Is in phase 2 of the 8(a) program and attended at least on 7(j) course</i>	0.04	0.21	0.00	1.00
<i>Age of the business in years</i>	11.65	6.24	0.00	50.00
<i>Located in the Washington, D.C. MSA</i>	0.26	0.44	0.00	1.00
<i>Located in a rural area</i>	0.02	0.12	0.00	1.00
<i>Located in an urban area</i>	0.06	0.24	0.00	1.00
<i>Located in an MSA</i>	0.92	0.26	0.00	1.00
<i>Primary industry is Manufacturing or Construction</i>	0.33	0.47	0.00	1.00
<i>Primary industry is Professional, Scientific, and Technical Services</i>	0.43	0.49	0.00	1.00
<i>Primary industry is other</i>	0.24	0.43	0.00	1.00
<i>Women-Owned Small Business</i>	0.32	0.47	0.00	1.00
<i>Veteran-Owned Small Business</i>	0.15	0.36	0.00	1.00
<i>HUBZone business</i>	0.10	0.30	0.00	1.00
<i>8(a) business with joint venture</i>	0.00	0.03	0.00	1.00
<b>Number of observations</b>	<b>3,678</b>			

Equation 3: Detailed specification of the multiple linear regression model to answer the third research question

$$Y_{it} = \alpha + \Gamma S_{it} + \varphi C_{it} + \delta M_{it} + \beta D_{it} + \rho A_{it} + \sigma R_{it} + \tau A_{it} * \sigma R_{it} + \sigma L_{it} + \theta I_{it} + \Pi_t + \varepsilon_{it}$$

Where,

$i$  = is the DUNS number of the 8(a) business;

$t$  = is the fiscal year;

$Y_{it}$  = is the percent of non-8(a) contracts in the federal portfolio;

$S_{it}$  = whether the 8(a) business is certified as a HUBZone business;

$C_{it}$  = whether the 8(a) business is a Veteran-Owned Small Business;

$M_{it}$  = whether the 8(a) business is a Women-Owned Small Business

$D_{it}$  = whether the 8(a) business is located in the Washington, D.C. metropolitan statistical area;

$A_{it}$  = whether the 8(a) business is in phase 2 of 8(a) program;

$R_{it}$  = whether the 8(a) business attended one course of the 7(j) training program;

$L_{it}$  = vector of variables that capture the location of the HUBZone business: rural area, urban area, and metropolitan statistical area;

$I_{it}$  = vector of variables that capture the primary industry of the HUBZone business: manufacturing, construction, professional, scientific, and technical services, other industries, and if the primary industry information is missing;  
and

$\Pi_t$  = fixed effects that align with the fiscal year to control for changes across time.

**Table 37: Results of the multiple linear regression model developed to answer the third research question**

<b>Variable</b>	<b>Mean</b>	<b>Std. Error</b>
<i>Is in phase of the 8(a) program***</i>	-14.03	2.07
<i>Attended at least one 7(j) training course</i>	-4.16	3.05
<i>Is in phase of the 8(a) program and attended at least on 7(j) course</i>	4.09	4.01
<i>Age of the business in years***</i>	0.65	0.16
<i>Located in the Washington, D.C. MSA</i>	-1.88	2.28
<i>Located in an urban area</i>	6.42	7.00
<i>Located in an MSA</i>	9.75	5.91
<i>Primary industry is Manufacturing or Construction</i>	2.49	2.45
<i>Primary industry is Professional, Scientific, and Technical Services</i>	1.68	2.69
<i>Women-Owned Small Business</i>	1.06	2.18
<i>Veteran-Owned Small Business</i>	-4.32	2.55
<i>HUBZone business</i>	0.47	2.73
<i>8(a) business with joint venture***</i>	-13.83	2.34
<b>Number of observations</b>		<b>3678</b>

\*\*\*indicates statistical significance at the 1 percent level