# Organizational Design of Secondary Aviation/Aerospace/ Engineering Career Education Programs 

Susan Kelly Archer

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# ORGANIZATIONAL DESIGN OF SECONDARY AVIATION / AEROSPACE / ENGINEERING CAREER EDUCATION PROGRAMS 

By

Susan Kelly Archer

A Dissertation Submitted to the College of Aviation in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Aviation
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## By

Susan Kelly Archer

This Dissertation was prepared under the direction of the candidate's Dissertation
Committee Chair, Dr. David Esser, and has been approved by the members of the dissertation committee. It was submitted to the College of Aviation and was accepted in partial fulfillment of the requirements for the

Degree of
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Date


#### Abstract

Researcher: Susan Kelly Archer Title: ORGANIZATIONAL DESIGN OF SECONDARY AVIATION / AEROSPACE / ENGINEERING CAREER EDUCATION PROGRAMS

Institution: Embry-Riddle Aeronautical University Degree: Doctor of Philosophy in Aviation Year: 2020 Modern nations operate within a global economy, relying heavily on the aviation industry for efficient and effective transportation of passengers and goods. The Boeing 2018 Pilot and Technical Outlook Report indicated that over the next 20 years, the aviation industry will need almost two and a half million new aircrew and maintenance employees to meet anticipated global demand. The industry will also need engineers, aviation managers, and workers in other aviation and aerospace disciplines. Aviation and aerospace jobs require solid backgrounds in mathematics, science, and technology; the development of pre-college aviation / aerospace / engineering career education programs would presumably enhance student preparation in these areas and increase the workforce pipeline for the industry. The goal of this study was to identify and evaluate the underlying organizational factors of successful secondary aviation / aerospace / engineering career education programs, through application of measures traditionally associated with organizational theory.

Analysis of collected data involved exploratory factor analysis to identify underlying factors, confirmatory factor analysis to verify significant relationships between manifest variables and latent constructs and to ensure a good-fitting measurement model, and structural equation modeling to identify significant relationships


between latent constructs and achieve the best-fitting model of these relationships for the collected data. Variables were Likert-scale responses to literature-based survey items associated with organizational vision, leadership, communication, collaboration, decision-making, flexibility, accountability, resource availability, motivation, and learning. Additionally, participants were invited to provide comments related to any of the survey items to explain or add detail to their response selection. These comments were reviewed both as they related to individual survey items and for detection of underlying themes. Participants in the study comprised stakeholders associated with career education programs in the disciplines of interest, including students, parents, alumni, school / program faculty and staff, industry members, and advisory board members.

Hypothesis testing results suggested that the most important factor in predicting success for an aviation / aerospace / engineering academy or program is personal motivation related to learning. Though other underlying factors, including leadership / collaborative environment, organizational accountability, and resource availability were clearly related to perceived program success, they appeared to have indirect relationships with success. It is also important to recognize that a paired qualitative analysis of participant comments generated themes that transcended survey item topics, and the identification of these themes supported the conclusions from hypothesis testing regarding underlying factors. Personal motivation was the most commonly recurring theme in comments, supporting the hypothesis testing result indicating its predictive strength for an organization's success.

Understanding the constructs that are most closely related to an organization's success, as they are perceived by its stakeholders, offers current program leaders and groups interested in creating new programs evidence they can use to design the frameworks for their programs. Anticipated workforce shortages warrant study of how to increase the number of candidates not only in post-secondary academic and training programs, but to shift recruiting earlier through implementation of quality secondarylevel programs that are established on a foundation of research-based strategies for success.

## DEDICATION

This dissertation is dedicated to my parents, Thomas and Beverly Kelly. They raised me with the belief that one of life's greatest gifts is the opportunity to learn, and that pursuing academic excellence should be one of my most important goals. It is also dedicated to the intrepid adventurers who were my aerospace technology students at First Coast High School, inspiring me to be a better teacher and to focus my research on improving programs such as the one we created together.

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First, and foremost, I must thank Dr. David Esser for his incredible patience and support as this project required quite a bit more time and effort than perhaps we originally anticipated. I also want to recognize the members of my committee: Dr. Michael Wiggins who was immeasurably helpful with the intense IRB process associated with research that requires working with children; Dr. Soumia Ichoua whose statistical expertise was critical in working with the advanced methods for this project; and Dr. Thomas Serwatka who has been my academic mentor for more than 25 years - including serving on dissertation committees for both of my doctorates. Dr. Tim Brady's advice and research expertise were important in the early stages of the project. The research would have been impossible without the assistance of multiple school and district personnel, community program leaders, and the academy and program stakeholders who provided responses to the survey items and many detailed comments about their respective organizations.

I also need to thank my family for constant support and willingness to serve as a local sounding board for my thoughts and ideas about the project as well as their suggestions when I needed new ideas. My village for this project has been a broad combination of family, friends, former students, and colleagues, and many whom I have met along the journey. Each of you is definitely an integral piece of what I have learned and whom I have become.

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## CHAPTER I

## INTRODUCTION

Modern nations operate within a global economy, which relies heavily on the aviation industry for efficient and effective transportation of passengers and goods. Brown et al. (2007) quoted a Bureau of Labor Statistics estimate that 54\% of U.S. aerospace workers over the age of 45 were projected to leave the field within a year, which would leave a shortfall of approximately 6 million jobs. The Pilot and Technician Outlook Report (Boeing, 2019) indicated that over the next 20 years, the aviation industry will need almost two and a half million new employees to meet anticipated global demand. This report only addressed commercial pilot, cabin crew, and aviation maintenance personnel requirements; the industry will also need engineers, aviation managers, and workers in other aviation and aerospace disciplines. Retirement and attrition account for part of the workforce requriement, paired with changing workforce needs to support the rapic development of new advanced aircraft and technologies. Projected fleet growth and expansion of emerging markets will necessitate a significant shift in how the U.S. and international aviation stakeholdes prepare operators and technicians. In a 2011 U.S. Senate hearing on aviation operations, safety, and security, presenters advocated that educators, industry leaders, and other stakeholders need to encourage current and future generations to pursue careers in aerospace and manufacturing, much like past generations were inspired to compete in the space race (U.S. Senate ..., October 25, 2011). Aviation and aerospace jobs will require solid backgrounds in mathematics, science, and technology; the development of aviation / aerospace / engineering career education programs would presumably enhance student
preparation in these areas. The goal of this study was to develop a valid structural equation model that can be used in designing new programs and revising existing programs that may be struggling. Related objectives included identifying and evaluating the underlying organizational factors of secondary aviation / aerospace / engineering career education programs, through application of measures traditionally associated with organizational theory and evaluation of organizational design in business settings. Modifications to data collection and, subsequently, to the evaluation of hypotheses led to the incorporation of explanatory factor analysis in the development of the final model.

According to the Airport Cooperative Research Program (ACRP) Synthesis on aviation workforce development, programs within this discipline should encompass four primary constructs: (a) preparing participants to enter or re-enter the workforce; (b) developing learning opportunities for participants that will facilitate improving their performance; (c) implementing responses to changes affecting workforce effectiveness at an organizational level; and (d) engendering retention and succession of the workforce (Young, 2010). The ACRP manual included examples of training programs for current workforce members, education and training programs for potential workforce members, and integrated programs. The programs for current workforce members included instruction in basic skills and communications; technical skills; business, management, and strategic planning; and executive-level certification. The programs for potential workforce members addressed academic degree programs, internships and cooperative opportunities, and industry professional organization activities. The report recommended further research to develop a guidebook for aviation industry organizations to assist with workforce development planning. Young updated this report in 2017 and made the same
recommendation for a guidebook to support workforce development planning, but, to date, no manual has been produced by the ACRP. Such a guidebook should include recruitment strategies, methods for educating and supporting participants, and "best practices for organizational efficiencies" (Young, 2010, p. 29). The National Associate of Secondary School Principals developed the Breaking Ranks literature series, a research-based set of materials that school leaders could use for guidance in how to effect best practices in their organizations. Some of the research findings (NASSP, 2002) upon which Breaking Ranks is based include: (a) integration of academic and vocational curricula helps students attain problem-solving, decision-making, and higher order thinking skills (Nielsen-Andrew \& Grubb, 1992, Resnick, 1987); and (b) students who participated in a summer internship program sponsored by the Boeing Corporation increased their technical competence and reported having a better understanding of how the academic concepts they were learning in school were related to the Academy for Excellence and Career Exploration and the School-to-Career program in Hartford, CT, correlated with significant improvements in student achievement scores in English, mathematics, and science (Bruckerhoff et al., 2000). These types of research findings served as the foundation for Breaking Ranks recommendations that included: (a) integrating curriculum to build depth of knowledge, (b) designing high quality work for students, (c) connecting the curriculum to real-life applications, and (d) promoting cocurricular activities as integral to education (NASSP, 2002, p. 8). An updated study by NASSP (2011) made the same recommendations based on input from over 4000 stakeholders in 28 secondary schools across 21 states. These recommendations align directly with development of career and technical education programs.

School-based secondary education programs include a wide variety of thematic bases. Students enroll in these programs for a number of reasons. The most recent Association of Career and Technical Educators (2014) research report found that twothirds of career and technical education (CTE) students believe their career education will help them in future employment, and $60 \%$ of CTE students plan to pursue careers related to the discipline they studied in high school. When asked during the survey to identify reasons why they enrolled in CTE: (a) $62 \%$ of students said they enrolled to prepare for life after high school; (b) $56 \%$ said they enrolled to learn new skills; (c) $34 \%$ said they enrolled to learn more about a specific career; (d) $33 \%$ said they enrolled to improve on their existing skills; and (e) $30 \%$ said they enrolled to explore different careers (ACTE, 2014). Based on these statistics, one could presume that students expect that the career education program in which they choose to enroll will be current and programmatically sound. Unfortunately, the existing body of research within the education discipline does not necessarily align with this perspective. Most educational research in the area of career and technical education involves evaluation of student outcomes, such as graduation rates, dropout prevention, student retention within a program, or core content test score improvement, to determine program effectiveness (DeWitt, 2008; Fletcher \& Cox, 2012; Hackmann et al., 2018; Kreisman \& Stange, 2019; Passarella, 2018). In recent years, some researchers have begun to look at educational programs from a more global perspective, including examining attributes more closely aligned with organizational theory, but there are a limited number of studies in this area (Dixon et al., 2011; Jones, 2011; Kiliçoğlu et al., 2019; Loera et al., 2013; Thiry et al., 2017). More recent research has focused on individual industries and methods for integrating industry-
specific career education into the K-12 school setting (National Academies of Science, Engineering and Medicine, 2019) and general CTE programming with a focus on student outcomes (Passarella, 2018). There is still a gap in the body of organizational theorybased research, when one focuses solely on career education; the gap is even more evident when concentrating on aviation / aerospace / engineering secondary level career education. To date, there have been no empirical studies specific to aviation- or aerospace-related school-based education programs that focus on the organizational design of those programs. This study serves as a first step to minimizing the gap in the literature.

In examining aviation / aerospace / engineering career education programs from an organizational theory perspective, the variables to be analyzed derive from a theoretical framework based on the extant organizational theory literature. These variables, including motivation, leadership, teamwork, and vision, are not easily measured; they are best described as latent or underlying constructs associated with an organization's design and ability to function successfully. They are usually associated with observations of individual or group behaviors; the behaviors or opinions of organization stakeholders about those behaviors are measurable via observation or survey participation. Thus, an examination of an organization requires understanding the relationships between the measurable variables and the constructs for which they serve as indicators, as well as the relationships between the constructs themselves. According to Klem (2000), classical analysis techniques are not effective in studying these relationships because, individually, they are not comprehensive enough. Klem (2000) noted that factor analysis on its own, which can be used to associate the measured
variables with the constructs, does not allow for examining the possible relationships between the constructs. Likewise, the author recognized that path analysis, which can be used to examine possible causal relationships, is appropriate for investigating causal relationships between observed variables rather than constructs. Klem (2000) explained that SEM offers the researcher the ability to estimate regression parameters in a path analysis model for both observed and unobserved variables in causal rlationships. It should be noted that SEM itself does not detect the causal relationships; it is a process used to validate relationships that are established based on the extant related literature. The links between constructs derived from this theoretical basis can be estimated, and their level of significance can be calculated. SEM results also provide information about the overall fit of a hypothesized model to the data collected. In recent years, educational researchers and organizational theory researchers have begun to use SEM to try to explain the complex relationships between multiple types of variables in these hypothesized models (Karadağ, 2009; Kiliçoğlu et al., 2019; Loera et al., 2013; Mohtar et al., 2019). This study adds to the body of research in both organizational theory and education disciplines where SEM was the analysis method.

## Statement of the Problem

Schools and districts across the U.S. are opening aviation, aerospace, and engineering career academy programs with varying levels of success. Students enrolled in these programs may lose interest in aviation careers if the program in which they are enrolled is weakened because the organization is not thoughtfully designed and wellstructured. Statistics at the time of this project indicated that the aviation industry will need almost 2.5 million new employees between 2019 and 2038 to support the
tremendous growth projected to sustain expanding global economies (Boeing, 2019). This number includes forecasts of 804,000 new commercial airline pilots, 769,000 new maintenance technicians, and 914,000 new cabin crew members over a 20-year period. Attrition due to retirement alone was expected to account for $18 \%$ of the hourly-wage manufacturing workforce in the U.S. to $24 \%$ of the same group by 2015 (Hedden, 2012). Science and engineering employment in the U.S. is also projected to increase, and when coupled with attrition, the expected requirement is for almost 5.2 million scientists and engineers between 2016 and 2026 (Sargent, 2017). The industry, and by extension the U.S., can ill afford to lose potential employees because an educational program based on the premise of increasing the aviation / aerospace / engineering labor pool is not grounded in an organizational design that has proven successful. Research must investigate stakeholder perceptions of their programs to determine the constructs that are most closely associated with organizational-level success and how those constructs are interrelated, in order to generate a model for continued program success.

## Purpose Statement

This study examined secondary aviation / aerospace / engineering career education programs, through the lens of organizational design, with the goal of developing a set of effective structural equation models that could be used in conceiving new programs and evaluating existing programs that may be struggling. Understanding how the components of a successful program are interrelated will enable new or rebooting program stakeholders to make research-based decisions on how to adjust or modify their own program inputs. Though the original intent was to focus solely on programs that had been recognized as successful, the study expanded to include programs
with varying levels of success. This expansion allowed for a deeper understanding of the factors that explain organizational design of aviation / aerospace / engineering career education programs. Participants in programs that had faced hurdles in achieving their goals provided insight into how critical factors affect organizational success.

## Significance of the Study

The focus of secondary curricula is moving toward a more inclusive and comprehensive agenda (away from the perspective that all students must go to college, to one where students interested in careers that do not necessarily require a four-year degree are better accommodated in the instructional program). School districts are scrambling to re-incorporate career education after years of budget cuts and program elimination. There are currently approximately 7,000 career academies across the U.S., enrolling an estimated one million students (National Career Academy Coalition, 2018). Kemple (2001) identified three basic features of career academies: (a) employing a school-within-a-school structure, (b) teaching academic and career or technical coursework combined for a career-themed curriculum, and (c) developing partnerships with local employers. The school-within-a-school structure was developed to generate a supportive learning environment, tailored to individual student needs. Career-themed curricula were designed to enrich the educational experience of teachers and students. Partnerships with local employers would improve career awareness and allow for work-based learning experiences. Kemple explained that these features were a three-pronged approach to achieve primary goals of dropout prevention and preparation for college and careers. He developed a model to portray how the inter-reaction of organizational elements and
learning opportunity support should lead to expected high school and post-secondary outcomes (Figure D1).

According to the National Career Academy Coalition (NCAC) (2018),
While career academies have grown quickly, for the most part they have spread in a grass roots fashion. Thus, there are many interpretations of what a career academy is and what a high quality career academy should look like, as well as many instances where the term 'career academy' is used to describe other configurations. (p. ACADEMIES)

Career-themed programs created in haste, without appropriate organizational structure and planning related to the features and goals Kemple (2001) identified, are almost doomed to fail. This study examined components of aviation / aerospace / engineering programs' organizational design as they related to program level of success as perceived by stakeholders, to provide guidance that could be used by new and fledgling programs, as well as programs looking to "reboot" at the organizational level, in order to become successful. The research findings add to the body of research on organizational design in educational programs, components of career education programs that are most closely associated with program success, and the application of SEM to educational research. The findings support development of theoretical frameworks in CTE program design at the organizational level and provide practical guidance for current aviation / aerospace / engineering career education program leaders that can be used to strengthen their programs.

## Research Questions and Hypotheses

This research study examined theoretical relationships between latent variables identified in organizational theory and design literature as possible predictors for organizational success. The extant literature seemed to support a second-order model with success as an endogenous variable and organizational design constructs (vision, leadership, teamwork, motivation) as exogenous variables. Additional constructs (resources, flexibility, learning, and communication) were identified in the literature but seemed more appropriate as endogenous variables associated with two of the exogenous variables. The resulting research questions and related hypotheses are as follows. $\mathrm{R}_{1}$ : Is the endogenous variable success predicted by the four exogenous variables (motivation, vision, leadership, teamwork)? Are the parameter coefficients for each exogenous variable in the structural model significant?
$\mathrm{H}_{110}$ : The regression coefficient for exogenous variable motivation as a predictor for success is equal to 0 .
$\mathrm{H}_{11 a}$ : The regression coefficient for exogenous variable motivation as a predictor for success is greater than 0 .
$\mathrm{H}_{120}$ : The regression coefficient for exogenous variable vision as a predictor for success is equal to 0 .
$\mathrm{H}_{12 a}$ : The regression coefficient for exogenous variable vision as a predictor for success is greater than 0 .
$\mathrm{H}_{130}$ : The regression coefficient for exogenous variable leadership as a predictor for success is equal to 0 .
$\mathrm{H}_{13 a}$ : The regression coefficient for exogenous variable leadership as a predictor for success is greater than 0 .
$\mathrm{H}_{140}$ : The regression coefficient for exogenous variable teamwork as a predictor for success is equal to 0 .
$\mathrm{H}_{14 a}$ : The regression coefficient for exogenous variable teamwork as a predictor for success is greater than 0 .
$\mathrm{R}_{2}$ : Is the endogenous variable learning predicted by the two exogenous variables (motivation, teamwork)? Are the parameter coefficients for each exogenous variable in the structural model significant?
$\mathrm{H}_{210}$ : The regression coefficient for motivation as a predictor for learning is equal to 0 . $\mathrm{H}_{21 a}$ : The regression coefficient for motivation as a predictor for learning is greater than 0 .
$\mathrm{H}_{220}$ : The regression coefficient for teamwork as a predictor for learning is equal to 0 . $\mathrm{H}_{22 a}$ : The regression coefficient for teamwork as a predictor for learning is greater than 0 . $\mathrm{R}_{3}$ : Is the endogenous variable communication predicted by the two exogenous variables (leadership, teamwork)? Are the parameter coefficients for each exogenous variable in the structural model significant?
$\mathrm{H}_{310}$ : The regression coefficient for leadership as a predictor for communication is equal to 0 .
$\mathrm{H}_{31 a}$ : The regression coefficient for leadership as a predictor for communication is greater than 0 .
$H_{320}$ : The regression coefficient for teamwork as a predictor for communication is equal to 0 .
$\mathrm{H}_{32 a}$ : The regression coefficient for teamwork as a predictor for communication is greater than 0 .
$\mathrm{R}_{4}$ : Is the endogenous variable flexibility predicted by the two exogenous variables (motivation, vision)? Are the parameter coefficients for each exogenous variable in the structural model significant?
$\mathrm{H}_{410}$ : The regression coefficient for motivation as a predictor for flexibility is equal to 0 . $\mathrm{H}_{41 a}$ : The regression coefficient for motivation as a predictor for flexibility is greater than 0.
$\mathrm{H}_{420}$ : The regression coefficient for vision as a predictor for flexibility is equal to 0 . $\mathrm{H}_{42 a}$ : The regression coefficient for vision as a predictor for flexibility is greater than 0 . $\mathrm{R}_{5}$ : Is the endogenous variable resources predicted by the two exogenous variables (leadership and vision)? Are the parameter coefficients for each exogenous variable in the structural model significant?
$\mathrm{H}_{510}$ : The regression coefficient for leadership as a predictor for resources is equal to 0 . $\mathrm{H}_{51 a}$ : The regression coefficient for leadership as a predictor for resources is greater than 0.
$\mathrm{H}_{520}$ : The regression coefficient for vision as a predictor for resources is equal to 0 .
$\mathrm{H}_{52 a}$ : The regression coefficient for vision as a predictor for resources is greater than 0 .
$R_{6}$ : Is there a model that better fits the data than the original structural equation model?
$\mathrm{H}_{60}$ : The original model provides the best fit for the sample data.
$\mathrm{H}_{6 a}$ : There is at least one post hoc model that is a better fit for the sample data.

## Delimitations

Delimitations focus on possible issues with the population about which the study is designed, specifically how the sample and analysis method used might affect the generalizability of study results. According to Locke et al. (2014), delimit "means to define the limits inherent in the use of a particular construct or population" (p.16). In an effort to generate a sample large enough to use SEM as a hypothesis testing method, a search was done to identify as many secondary aviation / aerospace / engineering schoolbased career education programs (the original target population) as possible, resulting in the discovery that there is no available comprehensive list of these programs. It was necessary to invite participants from every program described in existing research or identified by professional career education groups or individuals involved in aviation / aerospace / engineering education. Some of these programs, such as the Civil Air Patrol, were not school-based programs. However, they shared similar purposes in introducing pre-college students to science, technology, engineering, and mathematics principles associated with, and careers in, aviation, aerospace, and engineering. Using this more comprehensive approach to developing the sampling frame could have led to issues with the original intent of the study, to examine successful organizational design, as some programs might not have met typical criteria used to determine secondary career education success. By including the construct success as part of the hypothesized model, with corresponding manifest variables that presumably would measure participants' opinions about the level of success a particular program had achieved, the generalizability of the study to U.S. secondary school and community-based programs was expected to be improved.

## Limitations and Assumptions

One limitation of this study was associated with development of the sample. Because this research involved the participation of secondary school students and employees, in many cases initial school district permission was required prior to inviting school-based participants to provide data. Based on responses from districts during the pilot study of the survey instrument, there was an expectation that some districts or schools would decline to participate. Though district approvals were obtained, some schools within those districts chose not to participate. In these cases, there may be information specific to the aviation / aerospace / engineering career education programs in those schools that were not included in this research analysis. This potentially missing information could lead to underrepresentation or non-response bias in the results, generating a model that is not completely generalizable to the population of secondary schools in the U.S. However, the large sample size combined with inclusion of participants in community-based programs from a wide variety of regions across the nation offered some respite from the potential effects of these types of bias.

An additional limitation associated with development of the sample was related to the sample size necessary for implementing the hypothesis testing methodology. The analysis methodology, SEM, requires large samples so the study required collection of data from multiple sources in each of the schools and programs that chose to participate; data collected via survey documents required many cases. Using an anticipated effect size of 0.25 (a conservative estimate that the amount of variation explained in the model is in the small to medium range) and statistical power level of $0.80(\alpha=0.05)$, given that there were 35 survey items associated with an anticipated eight latent constructs, the
minimum sample size to detect an effect was 271 with a minimum sample size of 89 for model structure. After data cleaning, the sample included 350 complete cases, which exceeded the minimum of 271 .

There was also a limitation associated with a large sample, as the test statistic calculated in SEM, $X^{2}$, is directly dependent on sample size. The larger the sample size, the more likely the test statistic will be large, leading to rejection of the null hypothesis. Thus, though the goal of SEM is failure to reject the null hypothesis, when a large sample may cause $X^{2}$ results that lead to rejection, there are additional methods for analysis that can reflect a usable and / or generalizable model. Byrne (2010) and Blunch (2013) identified additional fit indices, commonly referred to as ad hoc indices, which have been developed to assess models where a very large sample leads to rejection of original models for goodness-of-fit. Some of these include: (a) standardized root mean square residual (SRMR), (b) root mean square error of approximation (RMSEA), (c) parsimonious normed fit index (PNFI), and (d) confirmatory fit index (CFI). Many of the ad hoc indices are calculated using standardized values or percentages that allow for a better comparison of the hypothesized model and the sample data.

Assumptions that were necessary for this research included that the sample was representative of the population though data collected were voluntary responses, and that the survey items were appropriate for the constructs under consideration. Though the use of voluntary response data can lead to underrepresentation or non-response bias, the utilization of a large sample drawn from a wide variety of regions and programs should have mitigated these biases and supported generalizability. Initial validation of survey items through use of a pilot study and examination of the survey instrument by subject
matter experts (SMEs) provided substantiation that the items, though derived from organization theory literature for business and industry, would be appropriate for evaluating educational programs. Kline (1998) presented a list of 35 issues with SEM for which the researcher should beware. This list is provided in Appendix E. Some of the items on this list served in part as content filters for developing survey items.

## Summary

Workforce needs for the aviation, aerospace, and engineering industries are projected to grow considerably over the next 20 years. Though this demand is increasing, the correlated supply of potential employees does not appear to be equivalent. It is imperative that quality career education programs in these three critical industries be expanded so that the demand for employees with the right academic backgrounds and practical skills can be met. While most research on educational programs focus on student outcomes such as graduation rates or college acceptance, aviation / aerospace / engineering career education programs needed investigation at an organizational level to develop a model for sustainable success. Using survey items associated with organizational design that were modified to describe educational programs and applying SEM as an analysis methodology to data collected from stakeholders in school-based and community-based programs, underlying constructs associated with program success were defined and their interrelationships described. The resulting model can be used by groups who are designing new secondary programs or intending to reboot programs that have struggled, so that they can focus on developing sustainable successful organizations.

## Definitions of Terms

Ad hoc Modification to model during analysis procedure
Common factor

Endogenous latent variable

Exogenous latent variable

Latent construct

Latent variable

Loading

Manifest variable Abstract theoretical phenomenon that is a linking basis for multiple observable variables Unobserved synthesis of ideas similar to a concept or phenomenon that is influenced by exogenous variable, directly or indirectly

Construct that is independent; causes fluctuations in other latent variables in the model Unobserved synthesis of ideas similar to a concept or phenomenon Unobserved underlying construct measured indirectly via relationships with observable variables Relationship between manifest variable and abstract theoretical phenomenon that is a linking basis for multiple observable variables associated with latent construct

Observed and measurable phenomenon that serves as an indicator for a unobserved underlying construct measured indirectly via relationships with observable variables

## Parameter

Post hoc
Regression estimate of relationship between independent and dependent variable in structural model

Analysis performed after initial model has been evaluated

## List of Acronyms

| ACRP | Airport Cooperative Research Program |
| :---: | :---: |
| AGFI | Adjusted goodness of fit index |
| AQAL | All Quadrants-All Levels/Stages-All States-All-Lines-All |
|  | Types |
| CAIC | Consistent Akaike's Information Criterion |
| CANSP | Career Academy National Standards of Practice |
| CAPE | Career and professional education |
| CEO | Chief executive officer |
| CFA | Confirmatory factor analysis |
| CFI | Comparative fit index |
| CMIN | Minimum chi-squared statistic |
| CMIN/DF | Minimum chi-squared statistic divided by degrees of |
|  | freedom |
| CN | Critical sample size |
| CTE | Career and technical education |
| DF | Degrees of freedom (sample size minus one) |
| ECVI | Expected cross validation index |
| EFA | Exploratory factor analysis |
| FAA | Federal Aviation Administration |
| GFI | Goodness of fit index |
| GoF | Goodness of fit |
| HPC | High performance culture |


| MSV | Maximum squared variance |
| :--- | :--- |
| NAF | National Academy of Finance |
| NCAC | National Career Academy Coalition |
| NFI | Normed fit index |
| NSOP | National Standards of Practice |
| PCA | Principal component analysis |
| PNFI | Relative fit index |
| RFI | Root mean square residual |
| RMR | Structural equation modeling |
| RMSEA | Standardized root mean square residual |
| SEM | Science, technology, engineering, and mathematics |
| SRMR | School-to-work |
| STEM | School-within-a-school |
| STW | Total quality management |
| SWS | TQM |

## CHAPTER II

## REVIEW OF THE RELEVANT LITERATURE

This literature review is divided into sections that focus on the major constructs under investigation: secondary career academies and programs, and organizational theory. The final section describes the analysis method, SEM.

## Secondary Career Education Academies and Programs

Modern career academies can trace their roots to 1960s Philadelphia, Pennsylvania. The Philadelphia Urban Coalition, an organization of city leaders, formed in the aftermath of inner-city riots to find solutions for the city's young people (Black, 2004). Philadelphia was experiencing a "high dropout rate and widespread unemployment" (Black, 2004, p. 38). The solution was creation of the first career academy at Thomas Edison High School, a school-within-a-school (SWS) model focusing on applied learning within the curriculum. Over the next 30 years, Philadelphia increased its academies, and by 2000 these programs served almost 7,000 students (Black, 2004). The earliest programs were designed with a more school-to-work (STW) focus; today's programs encourage students to pursue post-secondary education and training.

As career academy and specialized instructional programs were embraced by more schools and districts, accountability for the additional support and funding became a more significant facet of the work. The majority of subsequent research studies focused on initial program implementation, student-centered characteristics, and the measurable student outcomes. Some studies took broad views of National or State program implementation and impact. DeWitt (2008) wrote about the development of career and
technical education (CTE) programs and resultant successes in reducing dropout rates and improving academic performance. He described how programs across every state worked with local postsecondary institutions and industry stakeholders to design programs that would interest students and help them prepare for sustainable careers. DeWitt (2008) included a discussion of the States' Career Clusters Initiative to create and expand career clusters that serve as groupings for multiple academies or programs from common industries. In a 2019 study on vocational education, Kreisman and Stange reviewed high school and college transcripts as well as workforce outcomes for 4000 adults, finding that depth of study within a specialized vocational concentration rather than breadth across a more generalized curriculum tended to result in a significant increase in annual income.

Some studies have focused on efforts in individual states. DeArcos (2009) described the California Partnership Academies, a component of the restructured education system in the State of California that was aligned with the state's 15 industry sectors. She included a number of implications for action throughout the article that could be used as guidelines for an organization contemplating creation of a career academy at the secondary level; these implications focus on designing curriculum and program activities to engage students and facilitate their academic success and employability. More recently, Friedman et al. (2017) investigated how a summer pharmaceutical school internship for secondary students might impact recruitment to post-secondary STEM programs. Through case study analysis of 17 students from nine schools in the University of North Carolina area, they found that participation in such an
immersion program supported high levels of STEM and career awareness and was influential in post-secondary STEM programs of study.

The State of Florida passed the Career and Professional Education (CAPE) Act (F.S. 1003.491) in 2007, legislation requiring every school district in the state to establish a least one career academy by the 2008-2009 school year. This rapid deployment of new programs gave rise to educators' concerns regarding implementation and sustainability. Dixon et al. (2011) investigated three Florida career academies with respect to challenges the academies faced in implementation of the Career Academy National Standards of Practice (CANSP) and the relative success of different individual CANSP implementation. Their findings indicated success in real-world relevance of the curriculum and development of a sense of belonging for students. The most evident obstacles were student recruitment and cohort scheduling (students within the academy are scheduled for their academic core classes as a cohort). Evan et al. (2013) applied Geographical Information System mapping to data from Florida's PK-20 Education Data Warehouse to examine the variability in students' access to career academies and clusters in Florida public schools. In a similar vein, Fletcher and Cox (2012) examined career academy student recruitment and retention, centering their research on the meaning African American students from a Southeastern state assigned to participation in career academies and the challenges with which these students were confronted. Their findings indicated four underlying themes in a recognized shift in which African American student enrollment in career academies was not aligned with the high participation rates of students from this demographic in CTE courses: (a) preparation for the next level; (b) less
time for school activities; (c) not just going through the motions; and (d) unrealized connection with core academic subjects (Fletcher \& Cox, 2012).

There were also studies of programs at individual schools. Cannon and Reed (1999) discussed how career academies were implemented at South Grand Prairie High School in Grand Prairie, Texas. They described how faculty focus groups were used to determine the student group most in need of a dedicated curriculum program, how stakeholders investigated and decided on the most appropriate academies for the school, how the programs were implemented, and what the school's plans were for the future. Jones (2011) studied 20 years of data on multiple variables describing the Texas Academy of Mathematics and Science program, from its history and a brief description of its organizational design to student demographics and curriculum to student programs and alumni outcomes. He described the organizational structure and roles of key players, as well as how progress monitoring was accomplished. Jones (2011) also provided anecdotal examples of how difficult decisions were data-driven. However, he did not analyze the organizational design with respect to prevailing theories.

The body of research on career and technical education expands every year; however, the preponderance of the research is guided by examination of the student results, with measurement of dropout rates, grade point averages, standardized test scores, and post-secondary pursuits. Some studies touch on the organization of a particular program, but there has been little formal study of the career academy model through the lens of organizational theory. One study by Loera et al. (2013) investigated factors for two human services career academies in Southern California that are often associated with analysis of organizations. Loera et al. (2013) developed a survey
instrument to collect student responses regarding student characteristics: (a) educational aspirations, (b) perceived quality of the academy program of study, (c) adults' impact on college enrollment and students' high school outcomes, (d) satisfaction with student life, and (e) academic engagement (p. 178). They used SEM to analyze the relationships between the predictor characteristics and the outcomes separately. Findings indicated that only adults' impact on college enrollment was a significant predictor for academic engagement, while adults' impact and perceived quality of the academy program of study were significant predictors of satisfaction with student life. The implications for practice centered on the need for role models engaging more directly with students as they make educational and career choices, in order to facilitate students' making better decisions. These adult role models might correlate to the exemplary leaders studied by organization theory researchers. This particular study is important because the researchers used SEM to analyze career education data and because it shows what may be new emphasis of research on career academies: investigating characteristics beyond typically studied student outcomes. Another study of organizational characteristics looked at a community-based program (Thiry et al., 2017). Though this study examined a more general group of science, engineering, and technology pathway-based programs, the researchers did address organizational features of those programs, such as mission and partnerships beyond the organization. They found that participation levels by students from groups traditionally underrepresented in STEM courses or careers, recruitment practices, and program design tended to reflect an organization's mission or vision statement. A natural progression from these studies might lead to the current project that moves the concentration from student outcomes in career education or organizational
outcomes across a broader spectrum of STEM programs to examination of the career academy / program globally as an organization and specifically within the aviation, aerospace, and engineering fields.

## Organizational Theory

There has been extensive research in the discipline of organizational theory. One comprehensive study by Pryor et al. (2011) researched the development and evolution of organization, management, and leadership theory, using four underlying objectives: (a) study the history of multiple organization theories and their development from the perspective of legitimacy and efficacy; (b) evaluate debates on theory development; (c) support the use of data-driven theory development; and (d) offer a model and related theories from the review of existing work and determination of evident gaps. Similarly, Robledo (2013) examined models of management and organizational theories with the intent of supporting future research. Pryor et al. (2011) provided a narrative on existing theories, using traditional categorization (i.e., Classical Management, Scientific Management, Systems) to support future research grounded in standing theory as a method for evidence-based theory development. Robledo (2013) focused on how various models fall into one of four quadrants of a framework designed to classify the major schools of thought, with the intent that researchers would be able to understand multiple models and their relationships so that they could be integrated in newer developments and research.

Robledo (2013) used the All Quadrants-All Levels / Stages-All States-All-LinesAll Types (AQAL) integral map to frame his study of organizational theory. This map, developed by Wilber in 1995, divides a multi-faceted discipline into four quadrants
(Esbjorn-Hargens, 2009). These quadrants are distinguished horizontally by who is involved or impacted - the upper quadrants focus on the individual, while the lower quadrants focus on the collective or group. Vertically, the quadrants examine subjectivity, internal or self, (to the left) versus objectivity, external or others (to the right). An example of the resultant grid is shown in Figure 1.

|  | INTERIOR | EXTERIOR |
| :---: | :---: | :---: |
| 2 | UPPER LEFT | UPPER RIGHT |
| 0 $>$ - 0 | Intentional (subjective) | IT Behavioral (objective) |
| $\underline{z}$ |  |  |
| 山 |  |  |
| $>$ | WE | ITS |
| F | Cultural | Social |
| 4 | (intersubjective) | (interobjective) |
| ш |  |  |
| $\xrightarrow{-1}$ |  |  |
| 0 | LOWER LEFT | LOWER RIGHT |
| $\cup$ |  |  |

Figure 1. The four quadrants. Adapted from "An all-inclusive framework for the $21^{\text {st }}$ century: An overview of integral theory by S. Esbjorn-Hargens" (2009 Mar 12), in IntegralPost: Transmissions from the Leading Edge[Webpage]. Retrieved from http://integrallife.com/integral-post/overview-integral-theory. Copyright 2009 by IntegralPost.

Upper left quadrant - intentional. The upper left quadrant is classified as subjective because it is limited to (in this case) theories focused on an individual and his/her personal actions. Robledo (2013) classified Motivational Theories, Psychoanalytical Organization Theory, Managerial Theories, and the Strategic

Negotiation School in this quadrant, also calling it the Organization as a Psychic Prison (from Morgan's metaphors of the organization). He stated that it is the quadrant that takes a view inside the individual, examining how individuals create their own viewpoints, sometimes preventing them from seeing other points of view.

Motivational theories center on individual's beliefs, values, and goals. Eccles and Wigfield (2002) researched a number of these theories, classifying them into four major groups. These major groups were: (a) theories emphasizing expectations of success; (b) theories centered on task value; (c) theories in which expectancies and values are integrated; and (d) theories in which motivation and cognition are integrated. The theories examined by Eccles and Wigfield (2002) are shown in Table C1. These researchers focused on the developmental / educational psychology aspect of motivational theories, but the specific theories can also be applied to individuals' motivation for other aspects of organizational functioning. In a recent study, Wang and Liou (2018) used the theoretical framework of one motivational theory: modern expectancy-value theory, to investigate Taiwanese students' science learning, finding that students' motivational beliefs were predictors for science achievement. This theoretical model could be applied to other STEM curricula such as aviation, aerospace, and engineering.

Psychoanalytical Organization Theory investigates the interface between human nature and the organization as it manifests in behaviors that affect operational outcomes. Allcorn and Godkin (2008) examined communities of practice within organizations from a psychoanalytical perspective. They recognized that, positively, communities of practice promote organizational learning, augment collective memory, enable innovation,
and support organizational stability. They also identified negative attributes: communities of practice create silos within the organization with arbitrary boundaries and isolation of organization members. Allcorn and Godkin (2008) described application of psychoanalytical theory as taking advantage of the positive components of communities of practice while minimizing the effects of the negative components in order to overcome organization entropy. They suggested the following: (a) designing the communities in a manner that would orient members to issues and contingencies, with a focus on problem solving; (b) opening communication from within the community to outside stakeholders to foster knowledge networks, develop new opportunities, and support transformation capabilities; (c) engendering diverse member participation to broaden the knowledge base for the organization as well as its members; (d) developing public and private community spaces to expand potential dialogue; (e) concentrating on value to facilitate increased membership; (f) combining familiarity with excitement to enhance individuals' involvement; and (g) creating a community rhythm through regular communication and events that develop an expected routine or cycle that produces a dynamic organizational environment (Allcorn \& Godkin, 2008).

Managerial Theories include Managerial Power Theory (Schneider, 2013) and Managerial Theories of the Firm (Pass \& Lowes, 1978). Schneider (2013) examined Managerial Power Theory through its relationship to executive compensation. He identified a central implication that a number of executives earned significantly higher income than what market efficiency and maximum shareholder value would prescribe, essentially leading to executive compensation packages manifesting the principal-agent problem. The theory suggests that top executives derive organizational power from their
positions and use it to influence their compensation packages, which distorts their relationship with a Board of Directors and impacts membership on that Board. The implication is that managerial power can be used inappropriately by an individual member of an organization to increase personal gain, even while the organization itself is in decline.

Managerial Theories of the Firm focus on how an organization resolves conflicting goals (Pass \& Lowes, 1978). The researchers divided theories into two categories: satisficing, in which the focus is on organizational characteristics, and maximization in which static and dynamic properties of the organization are reviewed as they apply to production. Managerial theories are founded more strongly on more humanist behavior theory than on the work-product emphasis of classical theories. Pass and Lowes (1978) looked at large organizations, where there was a separation of ownership and control, delegating decision-making responsibilities to managers within the organization. The basis of managerial theory models was consistently self-interest, where growth of the organization's service or product led to improved salaries, status, power within the organization, and prestige.

Strategic Negotiation views organizational interactions and operations as situations requiring negotiation. According to Kennedy (2007), the process of strategic negotiation springs from a business plan, developing what he called operational imperatives. These organizational requirements are investigated and evaluated so that the commercial goals can be implemented in order to meet the goals of the business plan. The result of this process is a negotiation agenda that is effected to motivate members of the organization to perform the tasks / work necessary to achieve the plan goals.

Upper right quadrant - behavioral. The upper right quadrant is objective because the theories would examine behaviors of individuals outside the self. Robledo (2013) associated this quadrant with Morgan's Organization as an Instrument of Domination, assigning to it the Behaviorist School, Organizational Development Theory, Theory of Economic Behavior, and Radical Theory. He classified this quadrant as one in which theorists examine the negative side of organizations, looking at power structures and how authority is used to influence behaviors of individual group members.

The Behaviorist School, based on the premise that efficiency can be improved through an understanding of the behaviors of organization members rather than an understanding of the work, views interactions from a foundation of prediction and control of behavior. This set of theories is traditionally associated with John Watson and B. F. Skinner, to whom the suggestion that human behavior is a stimulus-response phenomenon is attributed. Skinner's work included four reinforcement contingencies: (a) positive, addition of a desired consequence to increase the frequency of a desired behavior; (b) negative, termination or withdrawal of an undesired consequence to increase the frequency of a desired behavior; (c) extinction, withholding a desired consequence to reduce an undesired behavior; and (d) punishment, addition of an undesired consequence to reduce an undesired behavior (Montana \& Charnov, 2000). Abramson (2013) refuted studying what he termed stereotypes of traditional behaviorism, introducing Watson's acknowledgement of the importance of human emotion, instinctive responses, and heredity, and Skinner's commentaries in which the researcher corrected trivializing criticisms of his work. Abramson (2013) also referred to a number of other
behaviorists whose work fell between Watson's and Skinner's with respect to motivating organization members.

Organizational Development Theory is most often applied when an organization is in the midst of some sort of change. Cross-organization teams are developed to attend to conflicts, with the intent of identifying causes and developing methods for solving the conflict issues by addressing the causes (Montana \& Charnov, 2000). The ultimate goal of these activities would be to improve organizational effectiveness and enhance individual members' well-being (Mulili \& Wong, 2011). Mulili and Wong (2011) synthesized findings from multiple studies to recommend that organizational development programs be ongoing to enable market or environmental sustainability. They identified five organizational development characteristics: (a) planned, proactive (rather than reactive) process, (b) macro-level focus on organization, (c) top leadership direction and involvement, (d) enhancement of problem-solving and renewal processes for goal and objective achievement, and (e) planned change or interventions with thirdparty assistance where necessary. The related intervention strategies were described as human-process based, techno-structural, socio-technical, and organizational transformation. Mulili and Wong (2011) concluded that organizations need to use a coordinated approach to implement the intervention strategies, to become learning organizations in order to cope with change, and to employ an effective communication system so that the intervention strategies can facilitate success. More recently, de Gooyert (2019) argued for a shift toward system dynamics to further study organizational development focusing on "understand[ing] the behavior of phenomena over time by mapping out the underlying causal relationships" (p. 654). Such investigation involves
identifying multiple levels of underlying constructs and the structural relationships between them and thus expanding the extant literature on organizational change. This study pursued the same objective but for a more narrowly defined type of educational organization.

The Theory of Economic Behavior is based on Karl Marx's theory of capital, in which the individual needs to survive and will thrive after the basic survival need is achieved. Marx suggested that the need for survival leads to economic order because individuals recognize the efficiency associated with collective labor and the related social structures. The conflict in this theory arises from the different perspectives of the subgroup Marx labeled capitalists - management and owners who wield power through investment, and the labor subgroup - the members of the organization performing the work. The theory emphasizes study of "social conflict and the dynamics of change within politically influenced capitalist economies"(Hatch, 2103, p. 23). Marx was also one of the founders of Radical Theory, along with later work by Weber and Michels (Morgan, 2006). According to Morgan (2006), the radical theorist sees the organization separated into antagonistic classes with dramatic social and political differences. The disadvantaged subgroup can promote its interests only through radical changes in the organizational structure, displacing the subgroup that currently holds power within the organization.

Lower left quadrant - cultural. Robledo's (2009) lower left quadrant was classified as intersubjective because it is associated with organizational theories that examine the group's interactions, similar to Morgan's Organization as Culture and Organization as a Political System. Robledo (2009) included Cultural Theory,

Anthropological Theory, Quality Management, Postmodernism, Business Ethics and Corporate Social Responsibility School, Knowledge Management, and Excellence Theories in the Culture classification and The Theory of Power in the Political System classification.

There are multiple aspects of Cultural Theory that can be studied. Karadağ (2009) investigated spiritual (or inspirational) leadership and organizational culture of primary schools in Istanbul, Turkey, through SEM. For the study, Karadağ (2009) developed two data collection scales: (a) a Spiritual Leadership scale for faculty and staff to rate leadership performance via subscales for commitment, vision, and productivity, and leadership attendance via subscales for belonging and believing; and (b) an Organizational Culture scale with four subscales to measure leadership effect on culture: administrative, social, value, and goal / objective. Though all of the variables Karadağ (2009) identified for the model were significant, the overall model only explained $67 \%$ of the total variance for the relationship between spiritual leadership perception and organizational culture. Karadağ (2009) recommended increasing the number of latent variables to improve the percentage of explained variability.

As this project is an investigation of the characteristics associated with program success, the discussion of Cultural Theory is confined to examination of high performing organizations. This focus combines Cultural Theory characteristics with those of Excellence Theories in the Culture Classification. Wriston (2007) examined organizations he classified as having high-performance cultures, defining a high performance culture (HPC) as "a mind-set - with accompanying and reinforcing habits, practices and routines - about how to optimally engage one's human resources in order to
optimize long-term team / organizational performance" (p. 9). Wriston introduced four interrelated components: (a) a collaborative environment, (b) accountability, (c) focus, and (d) robust processes. The collaborative environment should transcend all levels of the organization; all members believe their thoughts and perspectives are valued within the organization, and they are obligated to contribute consistently. Wriston related findings by Tamm and Luyet that collaborative networks developed by exceptional employees were associated with a significant positive performance differential. He suggested that a collaborative environment would be the foundation of an HPC. This environment would center on a common vision for the organization's future. The second component of Wriston's HPC description was accountability. He stated that a culture of accountability follows three consistent values or procedures: (a) clear expectations for personal performance and behavior; (b) recognition, reinforcement, and reward for exceptional performance; and (c) efficient and just attendance to performance problems. The third component of an HPC, focus, is described as the organization's ability to limit goals so that clear priorities are identified and significant work can be accomplished (Wriston, 2007). The final HPC component, robust processes, is defined as a collection of extraordinarily efficient and effective methods for accomplishing work. These processes center on the needs of the customer and the ability of the organization to execute its mission. Robust processes support the other three HPC components because: (a) they facilitate collaborative success in achieving goals; (b) the support process ownership by organization members and teams so that the culture of accountability is maintained; and (c) they support focus through efficiency and effective procedures (Wriston, 2007).

Anthropological Theory examines the organization as what Morgan (2006) referred to as a socially constructed reality in the perception of its members. It is closely associated with Culture Theory, focusing on the group dynamic within the organization.

Quality Management, with roots in statistical methods applied to quality control by Shewhart in the 1920s, is most commonly associated with Total Quality Management (TQM) which is one type of quality management system. TQM is a set of management practices, based on Deming's, Juran's, and Feigenbaum's work, that are systemic to an organization with a primary focus on meeting or exceeding the customer's needs (Merih, 2016). Deming suggested that an organization's sustainability is based on its success at continuous improvement, and that leadership's ultimate responsibility is to develop the organization so that it systemically moves from continuous improvement to continuous innovation (Perdomo-Ortiz et al., as quoted by Richards, 2012). Goals of the system are both internal - complete employee involvement from the chief executive officer (CEO) to the line worker, to constantly review policies and procedures in an effort to improve the organization, and external - customer loyalty through product or service improvement to meet customers' needs. Juran suggested steps in quality planning from identifying the customer to optimizing product (or service) features to meet organizational and customer needs. An underlying mantra of TQM is to "get things right the first time," allowing for significant reductions in product or service cycle time. Additionally, involving customers and suppliers as stakeholders facilitates loyalty and better product or service design through development of a larger information base.

Shifting from a focus on quantitative measurement of production to a total qualitative approach shows the influence of a more humanist side of organization theory.

In a recent study, Aniskina and Terekhova (2019) examined organizational management processes in a school setting, identifying the learning process as educational services provided by faculty. Their findings suggested that offering faculty the opportunity to develop and implement innovative training practices would improve a school-based quality management system.

Postmodernism interprets organizations with respect to power. The theory epistemology rests on the belief that nothing is truly real, so it is therefore impossible to find complete truth (Hatch, 2013). This lack of truth leads to the use of individual interpretations and indicates that an assertion of knowledge is a power play. According to Hatch (2013), interactions between organization members that are based on an existing power structure lead to oppression, irrationality, and misrepresentation. These interactions can also lead to humor and irony; the theory is inclined toward the marginalized and oppressed viewpoints, with the goal of deconstructing modernist theory that focuses on structure, rules, standardization, and routine (Hatch, 2013).

Business Ethics and the Corporate Social Responsibility School encompass a series of approaches that describe how an organization assumes social responsibilities and obligations. Obligations are required by law. Organizations approach social responsibilities from proactive or reactive perspectives (Montana \& Charnov, 2000). Proactively, an organization is expected to anticipate social issues, develop plans for avoidance of negative issues or potential problems that will also benefit the community, and implement those plans. Reactively, the organization is expected to deal with issues as they arise, with input from members of the organization as well as from the
community. The actions taken by the organization are not supposed to have a negative impact on the organization's purpose and goals.

Knowledge Management theories view intellectual assets as the most valuable to an organization interested in increasing capacity within its discipline. Scatolin (2013) suggested that a "knowledge economy" is materializing as a tangible reality, and that an organization can achieve its goals more quickly by investing in its knowledge assets rather than investing the same amount in material assets. He quoted James Brian Quinn, suggesting that $3 / 4$ of the added value for organizations is associated with possession of specific knowledge. Scatolin analyzed work by Nonaka and Takeuchi, who developed the theory of Knowledge Management as a method of describing increases in innovation and effective practices of Japanese companies and developed the schema that knowledge creation leads to continuous innovation which leads to a competitive advantage. He described the organizational knowledge spiral as having two dimensions: ontological, in which knowledge is created by individuals and the organization develops its knowledge base from developing conditions that facilitate interactions between individual members; and epistemological, in which tacit knowledge is "personal, specific to the context and difficult to be formulated and communicated" (Scatolin, 2013, p. 684), while explicit knowledge is coded to make it transmittable in formal and systemic language. As the dynamic relationship internal to epistemological knowledge transcends from one ontological level to another, the spiral is created (Fig. 2). The four quadrants of the graph: (a) socialization, (b) externalization, (c) combination, and (d) internalization, serve as phases through which knowledge moves from tacit to explicit and then back to tacit. The left side of the graph is where knowledge is tacit, while the right side is where
knowledge is explicit. The upper quadrants are where knowledge is held or learned by individuals, while the lower quadrants are where knowledge is held by the group or organization. It is interesting to note that these quadrant relationships are similar to those in the AQAL model.


Figure 2. Knowledge spiral. Adapted from Knowledge management: The eastern theory of organizational knowledge construction by H.G. Scatolin (2013) in Psychology Research, 3(11), p. 685, Copyright 2013 by David Publishing.

One of the modernist developments in organizational theory was the Theory of Power in the Political System. Theorists such as Bacharach and Lawler suggested that "survival in an organization is a political act. [Organizations such as] corporations, universities, and voluntary associations are arenas for daily political action" (as quoted by Hatch, 2013, p. 230). This theory evaluates decision-making processes as manifestations of political power wielding. In a strongly hierarchical organization, decision-making would be an example of bureaucratic use of power because the decisions are directed
downward from top management. In an organization that has a much flatter structure, politically-based decision-making might be more closely related to strategic negotiation.

Lower right quadrant - social. The final quadrant in the lower right corner was the inter-objective or social classification for organizational theories that study whole organizations. It contained the largest number of theories and was associated with Morgan's Organization as a Machine, Organization as an Organism, Organization as a Brain, and Organization as Change and Transformation. The Machine classification, associated with action-reaction, prediction, and ease of control, included structural theories such as Classical Theories, Scientific Management, Quality Management, and Quantitative Theories of Management. In their narrative on the development of organization theory, Pryor et al. (2011) referred to three early classical management theorists: Max Weber, Henri Fayol, and Lyndall Urwick. Weber emphasized "division of labor, centralization of authority, and [establishment of] organizational rules and regulations" (Pryor et al., 2011, p. 4). Fayol was more closely associated with the components of organizational administration: (a) planning, (b) organizing, (c) command, (d) coordination, and (e) control (Prior et al., 2011). Fayol is also credited with the 14 General Principles of Management: (a) unity of command, (b) unity of direction, (c) discipline, (d) division of work, (e) authority and responsibility, (f) remuneration, (g) centralization, (h) scalar chain, (i) order, (j) equity, (k) stability of tenure and personnel, (l) subordinate of individual to general interest, (m) initiative, and (n) esprit de corps (Pryor et al., 2011). Urwick expanded Weber's and Fayol's theories to include span of
control, line-staff relationships and functionalism, and the need for understanding the scientific knowledge of organizational theories.

The dramatic changes in how products were manufactured that were ushered in by the Industrial Revolution led to efficiency studies and the related theory. Leaders in this Scientific Management discipline included Frederick Taylor and Frank and Lillian Gilbreth. Taylor, recognized as the Father of Scientific Management, postulated that an organization would be more efficient if its procedures were based on findings from an empirical study of the "technical aspects of the work and the workers' psychological motivations" (Hatch, 2013, p. 25). He supported the use of work standards, uniform work methods, and skill-based job placement, supervision practices, and incentive programs. The Gilbreths designed time and motion studies with related measurement tools. They devoted their research to the study of worker productivity with the purpose of developing more efficient work methods to enhance that productivity. According to Pryor et al. (2011), many scientific management theorists were workplace practitioners who did not perform empirical research but collected data through observation in order to validate their theories.

Quantitative Theories of Management examine organizational dynamics from a measurement perspective. Researchers attempt to quantify characteristics of organizations in order to measure them and then apply empirical processes to analyze the resultant data to support decision making. Tanlamai (2011) evaluated the relationship between organization performance and use of quantitative management processes, identifying those processes as break-even analysis, quality control, forecasting, sampling and decision model. The research involved regression analysis, with findings that
application of advanced quantitative analysis techniques was significantly correlated to financial performance. These advanced techniques were discriminant analysis, exponential smoothing, chi-square analysis, Markov analysis, and non-parametric analysis. Tanlamai also found that application of advanced operations and production management techniques was significantly correlated to non-financial performance. These advanced techniques were inventory models, maintenance and repair models, and production scheduling.

Quality Management was described in the Lower Left section. It transcends the lower half of the AQAL model because it is used both internally and externally. Quality management techniques are used by groups to self-evaluate as well as by groups to investigate others.

The Organism classification, where the primary goal is survival, included the School of Human Relations, Psychosocial School, Organizational Development Theory, Contingency Theory, and Theory of Organizational Excellence. One of the most prominent series of investigations associated with the Human Relations Movement was the Hawthorne studies. These studies produced findings that humans did not always behave the way classical or scientific management theorists expected them to behave. The underlying premise of this movement was that humans did not always follow an expected behavior because the psycho-social nature of human relationships would impact individuals' decisions and actions. Improvements to the workplace at the Western Electric Hawthorne Plant did not result in improved productivity; peer group relations within the workforce had a much greater impact, with a logical and interpersonally
comfortable group being the most productive (Mayo, 1933, as quoted in Prior et al., 2011).

Descriptions of the Psychosocial School and Organizational Development Theory were provided in previous sections. These two theories transcend multiple quadrants of the AQAL model.

Hanisch and Wald (2012) examined how Contingency Theory influenced the study of organizations and management by focusing on how the organization fit the environment in which it was supposed to function. They recognized the historical work of Woodward, Burns and Stalker, and Lawrence and Lorsch, in which the situational components of work were integrated into management and organizational structure. Hanisch and Wald included a table showing the types of contingencies for which an organization might need to plan or make adjustments and the related characteristics or configurations within the organization where such action would be associated. The table is shown in Table C2.

The Theory of Organizational Excellence is aligned with quality management theories. Ringrose (2013) merged underlying principles and practical techniques of multiple structures for organizational excellence to develop a comprehensive framework that can be used by management consultants and quality practitioners in evaluating organizations. She used the EFQM Excellence Model developed for the European Quality Award, the Criteria for Performance Excellence developed for the Baldrige National Quality Program in the U.S., the Business Excellence Framework developed for the Australian Business Excellence Awards, and the Canadian Quality and Healthy Workplace criteria developed for the Canada Awards of Excellence. Ringrose identified
the unique constructs upon which each of the frameworks were based (Table 1).
Ringrose used the constructs to develop an organizational excellence framework that involves three concentric rings (Fig. 3). The inner ring is comprised of nine guiding principles: (a) leadership involvement, (b) alignment,(c) focus on the customer, (d) people involvement, (e) prevention-based process management, (f) partnership development, (g) continuous improvement, (h) data-based decision making, and (i) societal commitment.


Figure 3. Components of the organizational excellence frameworks. Adapted from "Development of an organizational excellence framework" by D. Ringrose (2013) in The TQM Journal, 25(4), 441-452. Copyright 2013 by Emerald Group Publishing Limited.

The middle ring is comprised of the foci for nine key management practices: (a) governance, (b) leadership, (c) planning, (d) customers, (e) employees, (f) work
processes, (g) supplies and partners, (h) resource management, and (i) continuous improvement and performance measurement. The outer ring reflects management responsibility for performance measurement and organizational responsibility for continuous improvement. Kiliçoğlu et al. (2019) studied organizational excellence from a negative perspective, examining organizational hypocrisy in educational settings. From their findings, they developed an empirical scale of organizational hypocrisy that indicated hypocrisy is a valid predictor of organizational cynicism in schools and is negatively correlated with organizational trust. These results indicate that there is a potential linearity to organizational excellence related to multiple predictive factors.

The Brain classification, most closely aligned with flexibility and changing environments, included Organizational Learning Theory, Knowledge Management Theory, and Theory of Economic Behavior. Knowledge Management Theory and the Theory of Economic Behavior were addressed in an earlier section and are referred to here because they are associated with changing environments. Morgan (2006) described learning organizations as those in which new technologies are used to develop the organization, using five principles. The first principle suggested ensuring the organization's visions, values, and sense of purpose serve as its corporate DNA and are encoded into all elements and protocols of the organization. The second principle discussed the significance of redundancy that would allow for innovation and development. The third principle would require diversity or variety within the organization because it is near impossible for every member of a large organization to possess every piece of knowledge and every skill for all possible tasks and activities. Principle four supported the use of minimum critical specification or focus on critical
variables, leaving room for autonomy when non-critical variables are involved in a protocol. Principle five defined learning in a self-organization as a double-loop process in which system operating procedures are modified as the wider environment in which they exist changes.

The Change and Transformation classification, explained as in constant change mode, included Systems Dynamics Theory and Chaos Theory. Systems Theory advanced the premise that every organization is part of a system; every function is accomplished by a system. Researchers investigate the interrelationships and dependence of the system variables. Systems theorists examine the different parts of a system, noting which parts are interrelated and how that interrelationship looks. They investigate system goals and procedures that link the different component parts. Karadağ (2009) investigated leadership and organizational culture through a framework of open system theory, in which the systems of the organization that interact with their environment are open (systems that do not interact with their environment are considered closed).

Chaos Theory originated in the discipline of meteorology. Edward Lorenz studied how tiny incremental changes to a weather equation led to dramatic changes in predictions over time. The sensitivity in Lorenz's mathematical models was viewed as similar to changes in different organizations and their management by 1980. Peters, in Thriving on Chaos: Handbook for a Management Revolution, described how changes to how business occurs, including approach of concurrent markets, expectations to decrease response time for client requests, rapid innovations, and employee satisfaction would require organizations to become much more adaptable to the ever-changing environment (Bogdan et al., 2013). At every step of a process, the organization is compelled to
examine environmental impact in order to make any necessary incremental modifications so that an end product or service is still viable in the market.

Table 1
Constructs that Form Bases for Evaluation Frameworks

| Country / Region | Constructs |
| :---: | :---: |
| Europe | Committing to social responsibility |
|  | Supporting diversity |
|  | Managing of risk |
|  | Analyzing image, brand, and effects of products \& services throughout their life cycle |
|  | Evaluating stakeholder awareness about policy and strategy |
|  | Managing finances, other assets, technology, information, and knowledge |
|  | Applying systems standards in process management to address quality, environmental, health, and safety |
|  | Marketing products and services |
|  | Measuring performance with respect to the customer, employees, society, and financial and non-financial outcomes |
| United States | Achieving good governance |
|  | Projecting performance |
|  | Managing knowledge |
|  | Preparing for emergency situations |
|  | Summarizing financial and marketplace performance results by customer and market segment |
| Australia | Achieving good governance |
|  | Defining strategic positioning |
|  | Contingency planning |
|  | Conducting capability gap analysis |
|  | Managing knowledge |
|  | Establishing strong culture |
|  | Understanding stakeholder objectives |
|  | Managing risk |
|  | Achieving sustainability |
| Canada | Achieving good governance |
|  | Guiding principles and practices for a healthy workplace |

Note. Adapted from "Development of an organizational excellence framework" by D. Ringrose (2013) in The TQM Journal, 25(4), 441-452. Copyright 2013 by Emerald Group Publishing Limited.

## Structural Equation Modeling

Structural equation modeling as a method for analyzing relationships between variables is considered more advanced than general linear modeling or other multivariate analysis methods that focus only on the relationship between observed and unobserved variables. Thompson (2000) described the increase in use of SEM by quoting Lomax who described SEM in 1989 as "the single most important contribution of statistics to the social and behavioral sciences during the past twenty years," and Stevens in 1996 who stated that SEM had "been touted as one of the most important advances in quantitative methodology in many years" (p. 261). According to O'Boyle and Williams (2011), SEM is a popular method used by organizational researchers because it allows for simultaneous investigation of the relationships between indicators and their underlying constructs and relationships between the constructs themselves. The data analysis method is a form of confirmatory analysis, in which hypothesis testing is considered easier to accomplish because the pattern of inter-variable relations is specified a priori (Byrne, 2010). It can be used to identify significant latent (unobserved) variables and their related manifest (observed) variables. Because the output provides regression parameters for each manifest variable and each latent variable, it is possible to determine via hypothesis testing which of the different groups of variables are significant and which can be eliminated from the original model in a post hoc model adjustment. Additionally, SEM provides explicit estimates of error variance parameters and procedures for incorporating both manifest and latent variables. Jöreskog (1973) described structural equation modeling for continuous variables as having two component parts: (a) a confirmatory factor model that associates observed or manifest variables to unobserved or latent
variables; and (b) a system of equations that form the structure to describe the relationships between the latent variables.

General assumptions and limitations. All hypothesis testing methods are based on a set of underlying assumptions. According to Kaplan (2009), there are four primary assumptions for SEM: "[a] multivariate normality, [b] completely random missing data, [c] sufficiently large sample size, and [d] correct model specification," combined with an additional assumption of exogeneity (p. 85). Multivariate normality is a requirement for maximum likelihood estimation. Each manifest variable should be normally distributed for the values of other manifest variables (Garson, 2015). Maximum likelihood also requires that endogenous variables have normal distributions. The normality assumption also forms a basis for an assumption of linearity (Garson, 2015). SEM assumes there are linear relationships between factors and their related manifest variables and among the factors themselves. Completely random missing data refers to observation cases for which responses to at least one survey item is missing. These missing data are considered completely random if, when the cases with missing responses are removed, the remaining observed cases form a random sample of the original set of cases. In other words, a particular survey item is not skipped consistently by one demographic subgroup of survey participants. Garson (2015) listed recommended rules of thumb for determining sufficiently large sample sizes. These included: (a) ensuring the sample included at least 50 more than eight times the number of variables in the model, (b) multiplying the number of variables by 10 to 20 to determine the number of cases needed, (c) including at least 15 cases per manifest variable, and (d) considering 100 to 200 cases to be the minimum sample size. Correct model specification occurs when the variables
included in the model are comprehensive in representing the phenomena being studied. Exogeneity refers to the existence of at least one exogenous variable in the model, serving as a predictor for at least one endogenous or manifest variable.

Because SEM is a confirmatory approach to analyzing a particular phenomenon, the relationships identified in a model must have a grounded theoretical base. Exploring possible relationships between variables would prove to be too cumbersome for a large number of variables, although post hoc analysis can be performed to modify an original hypothesized model. As with other hypothesis testing methods, the results of a significant SEM analysis can only be generalized to the population from which the sample was drawn.

Major steps for the modeling process. Kaplan (2009) outlined the general steps in SEM as the following: (a) specify the model; (b) evaluate the model for identification; (c) select the manifest variables, collect, prepare, and screen the data; (d) estimate the model; (e) re-specify the model; and (f) report the results. Specifying the model involves determining a path diagram that reflects relationships between exogenous and endogenous constructs and between constructs and measurable indicators. Model identification involves calculating the degrees of freedom in the hypothesized model. A positive number of degrees of freedom allows for scientific use of the model because it can be rejected via hypothesis testing (Byrne, 2010). Overidentified models, in which the number of data points (i.e., variances and covariances of observed variables) exceeds the number of parameters being estimated have positive degrees of freedom. Typically, one counts the number of observed variables, $p$, and then calculates $p(p+1) / 2$ to determine the number of data points (Byrne, 2010). The number of unknown parameters in the
model is subtracted from this value to calculate the degrees of freedom for the model. Estimation of the model involves evaluation of goodness of fit. If the model is considered poor but modification of the model is justified, it should be re-specified (step e). Such justification for the structural model involves examination of the estimated regression coefficients for relationships between constructs and covariances. Where estimates are not significant, the relationship should be removed. If the model is considered poor but modification of the model is not justified, it is not retained. If the model is considered to have a good fit, it is retained. A re-specified model would then be estimated again (step d would be repeated). Once a model is retained, the parameter estimates are interpreted. Additional post hoc analysis can be used to consider equivalent or near-equivalent models that may better fit the collected data.

## Gaps in the Literature

There have been multiple studies of career and technical (or vocational) education programs, with some focusing specifically on STEM initiatives. However, the majority of these studies examined student outcomes such as attendance, dropout prevention, grade or test score improvement, or workforce readiness. Very little research has examined career education programs at the organizational level, and to date, there have been no published studies on the organizational design framework (with focus on underlying factors) of aviation / aerospace / engineering career education programs. Historically, studies focusing on organizational design or framed by organizational theory focused on single or few elements without considering the multidimensionality of organizational phenomena and the effect of temporality and culture (Webering, 2019). This research project concentrated on the narrow area of aviation / aerospace /
engineering career education programs, integrating multiple frameworks from organizational theory, to begin closing the gap in the literature.

## Theoretical Frameworks

Design of the survey instrument for data collection included an evaluation of organizational theories from each of the four quadrants to choose theories most closely related to the constructs associated with the NSOP and NAF Distinguished Academy criteria (Appendix E). Robledo (2013) suggested that theory-based evaluation of an organization should include an integration of ideas from each of the four quadrants of the AQAL model. After reviewing the descriptions of the theories in each of the quadrants of Robledo's (2013) model, the following theories were selected for use in developing the survey instrument: Upper Left - motivational theory of modern expectancy-value; Upper Right - organizational development theory; Lower Left - high performance culture theory; and Lower Right - theory of organizational excellence. This project investigated the organizational design characteristics of successful programs, which involve individual motivation of organizational members, continuous improvement, high-performance culture, and organizational excellence. This theoretical basis for the survey items is shown in the model in Figure 4.


Figure 4. Theoretical frameworks model for studying organizational design, using the AQAL model. Adapted from "An all-inclusive framework for the $21^{\text {st }}$ century: An overview of integral theory" by S. Esbjorn-Hargens (2009 Mar 12), in IntegralPost: Transmissions from the Leading Edge [Webpage]. Retrieved from http://integrallife.com/integral-post/overview-integral-theory. Copyright 2009 by IntegralPost.

The following descriptors were developed from the theoretical foundation for each of the individual theories that were included in the model. These descriptors were used to develop the survey items.

Individual Interior (Personal Motivation)
Modern Expectancy-Value Theory has three major components:

- Expectancy - the degree to which the individual believes that putting forth effort will lead to a given level of performance
- Instrumentality - the degree to which the individual believes that a given level of performance will result in certain outcomes or rewards
- Valence - the extent to which the expected outcomes are attractive or unattractive

Individual Exterior (View of Others' Participation / Value)
Organizational Development Theory is focused on how change is managed within an organization. Components include:

- Employee satisfaction
- Communication
- Team collaboration
- Strategic performance / Vision
- Knowledge (information) management
- Growth

Collective Interior (Within Group Interaction)
High Performance Culture Theory has four major components:

- Collaborative environment
- Accountability
- Focus / Vision
- Robust processes

Collective Exterior (Perception of Group from Outside)
Organizational Excellence Theory has nine guiding principles with eight overlapping management practices that are related to those principles. They are outlined in Table 2.

The organizational theory upon which this study was based led to the identification of both observable variables and unobservable constructs that were presumed to be associated with these observable variables. It is the ability of the researcher to simultaneously examine both the measurement model to focus on relationships between observed phenomena and unobserved constructs and the structural
model to concentrate on the relationships between these unobserved constructs, that made SEM the most effective choice of hypothesis testing method for investigation of the complexities associated with the theoretical attributes of organizational design.

Table 2

Principles and Practices of Organizational Excellence

| Principle | Practice |
| :--- | :--- |
| Leadership Involvement | Governance |
| Alignment | Leadership |
| Focus on the Customer | Planning |
| People Involvement | Customer |
| Prevention-based Process Management | Employees |
| Partnership Development | Work Processes |
| Continuous Improvement | Supplier and Partner |
| Data-based Decision-Making | Resource Management |
| Societal Commitment |  |
| Note. Adapted from "Development of an organizational excellence framework" by D. |  |
| Ringrose (2013) in The TQM Journal, 25(4), 441-452. Copyright 2013 by Emerald |  |
| Group Publishing Limited. |  |

The first goal of this study was to identify the most significant underlying constructs associated with successful secondary-level aviation / aerospace / engineering career academies and programs and the manifest variables linked to these constructs. Because the underlying constructs were not directly measurable, they were associated with manifest variables in the form of survey items that describe behaviors of organizations and individuals who are involved with those organizations. The second goal was to create a series of equations that define the relationship between the underlying constructs and between the underlying constructs and the manifest variables.

Research model. The study used a hypothesized second-order model for SEM analysis that was based on the combined theory described in the last section of the review of literature. Using the theoretical foundation which served as the focus of this study (Fig. 4) and the associated descriptors, the constructs identified for the model were communication, flexibility, leadership, learning, motivation, resources, teamwork, and vision, with an outcome of success. Relationships between these constructs, shown in Figure 6, were hypothesized from the theoretical framework and literature. Karadağ's (2009) suggestion that one consider more than two latent variables (leadership and culture) indicated that the model should include relationships between multiple constructs. The career academy literature indicated an important connection between role models and / or program success, suggesting that the construct leadership should have a direct relationship with the outcome variable of success (Jones, 2011; Loera et al., 2013).

Examination of components of culture led to development of additional constructs. Teamwork (defined as a collaborative environment) and vision (defined as focus) were two of the four interrelated components that Wriston (2007) identified as key parts of high-performance cultures, indicating a direct relationship with success for each of these constructs. Mulili and Wong's (2011) findings indicated that the constructs of flexibility, learning, and communication are necessary to facilitate success, but identified them as intervention strategies which suggested that though these constructs might be related to the culture and organizational design of a successful academy / program, they were likely not directly related to success. Flexibility can be associated with persistence and choice for the individual. In Modern Expectancy-Value Theory, these constructs are linked to motivation (Table C1). Mulili and Wong (2011) implied a link between
flexibility and organizational vision in their explanation of how an organization develops and implements intervention strategies that align with the organization's purpose, to facilitate success. Wriston (2007) also linked flexibility and vision in his description of robust processes, recognizing that goal achievement relies on continuous improvement of efficiency and use of effective procedures. Eccles and Wigfield (2002) associated learning, described as cognition with motivation for an individual; Allcorn and Godkin (2008) examined organizational learning, describing how communities of practice promote learning which implied a relationship between learning and teamwork. Communication is a social construct within an organization. Ringrose (2013) associated social relationships between organization stakeholders (as well as with outsiders), which would require communication, with leadership and collaboration, which could be considered teamwork. Wriston's collaborative environment, which he suggested would be a foundation of a successful organization, involved consistent stakeholder contribution - implying the link between communication and teamwork. Another common factor related to organizational success in the literature was resources or resources management. Whether identified as human resources in Organizational Development and High Performance Culture Theory or physical resources in Organizational Excellence Theory, resource management is associated with underlying constructs of vision and leadership.

The motivation construct was assumed to have a similar direct relationship with success based on Robledo's (2013) model and the findings by Eccles and Wigfield (2002) that motivation and expectations of success are related by an individual's beliefs, values, and goals, combined with the fact that the data for this study were opinions of individual stakeholders with respect to their academies / programs.

Survey items were developed to serve as manifest variables for each of the constructs. The survey items associated with each construct are shown in the Figure 5. Research questions were generated from the measurement model and the structural model (Figs. 5 and 6).

Hypotheses and support. The first set of research questions and associated hypotheses concentrated on the constructs included in the hypothesized model. The primary research question focused on the variable that one might perceive as the desired outcome for the phenomena being studied. In this study, the construct associated with program outcomes was the endogenous variable success. A subsequent set of research questions were derived from relationships between endogenous and exogenous variables that were indicated in the hypothesized model. These questions allow the researcher to determine if such relationships are significant. Additional questions prompted investigation of relationships between manifest variables and latent constructs, interrelationships between latent constructs, and whether a better model could be developed in post hoc analysis.


Figure 5. Measurement model showing relationships between survey items (manifest variables) and underlying constructs for CFA Analysis of data.


Figure 6. Conceptual model for SEM analysis of data.

## Summary

A review of the related literature suggested that new research should continue the examination of career and technical education academies and programs but move beyond the traditional focus on school-based student outcomes such as attendance and dropout prevention, impact on grades and standardized test scores, or workforce readiness (Friedman et al., 2017; Hackmann, Malin, \& Ahn, 2018; Hackman, Malin, \& Gilley, 2018; Kreisman et al., 2019; Passarella, 2018). Though some recent research has focused on STEM programs (Finkel, 2016; Icel, 2018; Mohtar et al., 2019; Turner et al., 2016),
these studies continue to concentrate on student outcomes with only a few (Kiliçoğlu et al., 2019; Thiry et al., 2017) investigations of educational programs at the organizational level. Recent congressional testimony (Lang, 2020) reflected current forecasts of significant aviation workforce needs, with related requirements for development of education pathways prior to high school graduation. Such pathways should be designed with dual focus on expansion of positive student outcomes and development of researchbased, sustainable organizational structures. This project should provide some of the research basis to design sustainable organizations.

## CHAPTER III

## METHODOLOGY

This section describes how the study was conducted, explaining the research methodology related to research questions and sample selection based on the population of interest.

## Research Method Selection

When evaluating multivariate relationships involving observable variables and unobservable constructs, there are two approaches to development of an analysis model. If there is sufficient extant literature related to the general topic being studied, one can develop a hypothesized model to describe relationships between variables and constructs based on an organizational theory foundation. Grimm and Yarnold (1995) described the CFA phase of SEM as a "tool for theory testing" (p. 109). However, if the phenomena under investigation are new or being studied in a new way, it is necessary to first analyze the observable variables via EFA to identify unobservable constructs to which they are most closely related. Kline (1998) recognized that, though SEM is an a priori modeling technique, "[m]any applications of SEM are a blend of exploratory and confirmatory analyses" (p. 8). He further explained that when data are inconsistent with a hypothesized model, the researcher is compelled to modify the hypotheses or abandon the original model completely. In cases using a hypothesized model based on theoretical frameworks derived from the extant literature where the results indicate a poorly fitting model, Byrne (2010) suggested a different approach for post hoc analysis that begins with EFA. Where CFA is used in "theory testing," EFA is used in "theory development" (Tabachnick and Fidell, 2018, p. 662). So, if the theoretical framework being tested
through use of a hypothesized model does not fit the data collected, it is sometimes necessary to develop a new theory about the phenomena being studied that can be derived from the data via EFA. Based on the literature review and the survey instrument pilot study results, an initial hypothesized model was developed for this study. Hypothesis testing of the structural model occurred after EFA and CFA steps to generate the measurement model that best fit the collected data.

## Population/Sample

The population for the study included stakeholders associated with secondary schools and community programs where aviation / aerospace / engineering career education programs were in place.

Population and sampling frame. Stakeholders included students, career education teachers and instructors, career education program coaches, core content teachers of cohorted career education students, school-based and district-level administrators and resource teachers, community-based program administrators, school staff, parents, advisory board members, and academy and program alumni. At the time of this study, there was no single comprehensive list of existing aviation / aerospace / engineering academies and / or programs; likewise, there was no single clearinghouse for career education programs overall, although states and school districts have begun to adopt standardized career pathways based on nationally recognized CTE career clusters. The sampling frame was developed through internet searches for high schools with aviation, aerospace, or engineering curricula, the database of points-of-contact for Embry-Riddle Aeronautical University's student recruitment office, Embry-Riddle's own Gaetz Institute, and internet searches for aviation, aerospace, and engineering-based
community programs such as Girls Code and the Civil Air Patrol. Additional groups that were contacted for potential participants were Women in Aviation, International and the Black Pilots' Association, as these groups sponsor events and programs for pre-college students.

Sample size. In drawing the sample data, there were specific recommendations regarding sample size for SEM. According to Blunch (2013), sample size controls or at least impacts: (a) precision and stability of the model, (b) power of the statistical tests being run, and (c) efficiency of the fit measures available for analysis. Blunch stated further that "the complexity of the model, the estimation method, and the distribution qualities of the data" affect the sample size necessary to achieve useful results (p. 103). Thompson (2000) combined the suggestions of several researchers to suggest that the sample size should be a minimum of at least ten times the number of observed variables. Given that there were 35 survey items, the minimum sample size for this study was 350 . Thompson also indicated that the more complex a hypothesized model is in its path design, the larger the sample size should be. More recent guidance suggested a smaller sample would be adequate. Using the online Free Statistics Calculator (Soper, 2020), with an anticipated effect size of 0.25 , desired statistical power level of 0.80 , the hypothesized eight latent variables and 35 manifest variables, and a significance level of 0.05 , the minimum sample size to detect an effect was 271 , and the minimum sample size for model structure was 89 .

Sampling strategy. The sample was a purposeful sample. Given that the data collection was by voluntary response to an online survey, it was necessary to delimit those who had access to the survey to ensure that only stakeholders in aviation /
aerospace / engineering career education programs would provide information. Initially, programs with recognized success were targeted because the focus of the study was on underlying factors that were associated with best practices. Successful programs were defined as those academies that have achieved National Model status from the National Career Academy Coalition (NCAC), Distinguished Academy status from the National Academy of Finance (NAF), or have evidenced excellence through documented student academic achievement measures and alumni successes in the aviation, aerospace, or engineering disciplines. In 2009, the NCAC used the National Standard of Practice (NSOP) to establish an assessment process for career academies that would identify best practices and strong or model programs (NCAC, 2014). The standards which the NCAC applies in its assessment and a bulleted description of the NAF Distinguished Academy criteria are provided in Appendix F. Because there were only three National Model aviation career academies and not all National Model or Distinguished engineering academies include aerospace components, it was necessary to expand the definition of successful academy or program to include those organizations that have documented success via student academic outcomes, are recognized in their communities for association with aviation / aerospace / engineering career education, and / or have documented success via alumni involvement in aviation / aerospace / engineering. In order to also understand factors that might hinder an organization's success, the sample was further expanded to include any program with aviation / aerospace / engineering components. Participants in the study were asked to identify how their respective programs were recognized as successful. It was expected that if a program was less than successful or struggling, the participant would rate the survey items associated with
program success lower on the scale than those participants who were associated with successful programs.

## Data Collection Process

The data collection process occurred over a two-year period from March 2016 through July 2018, using an online survey platform. Though there were more than 450 responses, only 350 included completed, usable surveys.

Design and procedures. Based on review of the extant literature, a conceptual model was developed. Constructs were identified from literature focused on both pedagogy and organizational theory, and hypotheses were formulated for the conceptual model. Survey items were pilot-tested to design an instrument for data collection that would elicit responses that could describe the constructs in the conceptual model and their relationships. Data collection involved use of an online survey of aviation / aerospace / and engineering career education academy and program stakeholders.

Apparatus and materials. The survey was delivered via SurveyMonkey.com. According to Evans and Mathur (2005), the advantages of using online surveys include the following: (a) global reach, making it possible to include participants from geographically separated areas, which should increase the generalizability of a study based on a broader sampling frame; (b) flexibility of format to embed a link to the survey URL in an email to potential participants; (c) speed and timeliness, significantly reducing the time needed to get a survey into the field and collect data; (d) technological innovations that allow for randomization of items or pages of items to reduce bias; (e) convenience for participants to respond at times that meet their personal schedules; (f) ease of data entry and analysis, because responses are programmatically-recorded,
organized, and stored; (g) diversity of item format; (h) low administration cost due to self-administration by participants via available internet access; and (i) go to capabilities, in which the participants respond to items that pertain to them, specifically, while a skip function allows for avoidance of items that do not pertain to them. Evans and Mathur (2005) recognized that disadvantages of online surveys include the following: (a) perception as junk mail, due to spam screening programs within email programs; (b) questions about sample selection (representativeness) and implementation because an unintended participant can respond by entering the survey; (c) participant's lack of online experience or expertise for some subgroups of a study population; (d) technological variations in internet connections and specific configurations of participants' computers; (e) unclear answering instructions; (f) impersonal nature, in which no human contact may lead to reduced participant motivation; (g) privacy and security issues because participants may be concerned about their responses being intercepted or that an email attachment might have a virus; and (h) low response rate. The authors suggested methods for moderating these weaknesses, respectively, by: (a) using an opt-in survey, where participants receive an email with a URL link; (b) organizational selection with randomization when a large enough sampling frame exists; (c) use of simple instructions, and click on access to the survey; (d) use of standard colors and screen dimensions, as well as pop-up technology; (e) pretesting of the items with comment boxes available; (f) including information about the participant or participant's organization; (g) including clear, highly visible, participant-friendly policies; and (h) limiting the number of contacts requesting participation and using recognized survey techniques.

The data collection survey for this study was available via an online survey program on SurveyMonkey.com via a hyperlink, or URL code, that was provided to all potential participants. Because academy and community-based program students were usually under the age of 18 , they were provided this information when they returned a permission slip signed by their parent or guardian (Appendix G). This permission slip was separate from the informed consent agreement that was embedded in the online survey opening page. SurveyMonkey.com's program allows for an opening page that can include embedded informed consent, as well as randomization of items on a given page and randomization of the pages. By using a randomized order of items for each participant, it was possible to reduce bias due to item order or survey fatigue, in which a participant may be less likely to apply as much diligence to answering the last few items on a survey than the first items. The responses for each item were provided to respondents in radio buttons, a set of mutually exclusive selections that allows one and only one choice per item. Each item also had a comment box for additional input by respondents. SurveyMonkey.com provided the survey designer with resulting data in a variety of formats that were compatible with the analysis software being used in this study. Survey response choices were organized into an Excel spreadsheet that was uploaded to SPSS AMOS Graphics. Additional comments by participants were organized by survey item. In cases where at least three participants used a common word or phrase in their comments, those words or phrases were provided in a table with their frequencies and percentage appearance in the comments that were submitted.

Data were analyzed using SPSS Basic software for the EFA and SPSS AMOS Graphics software for CFA and SEM. AMOS Graphics provides an intuitive platform for
designing a structural equation model because the user develops a path diagram for the model and then identifies the data being used for manifest variables. Program output includes regression coefficient and error estimates in table form and displayed graphically on the path diagram. It is not necessary to learn a programming language to use SPSS AMOS Graphics, so the user is able to devote more time to examining and evaluating the analysis output.

Comments made by participants for individual survey items were analyzed for possible patterns. As there were only a relatively small number of participant comments (when compared to the sample size) for individual items, it was possible to identify indications of patterns or trends manually. An additional analysis for an overall sense of positive and negative concerns involved manual examination of the body of participant comments.

Sources of the data. The data were drawn using a survey instrument. When the NCAC performs its evaluations of career academies for Model or Certified status, or NAF performs its evaluations of career academies for Distinguished status, they use documentation associated with the program, observations, interviews, and item checklists derived from the NSOP. These sources of data are typical in evaluation of educational programs. It was not necessary to complete observations or interviews, as the survey instrument included opportunities for participants to add comments.

## Ethical Consideration

Consideration of research ethics is one of the most crucial responsibilities of the researcher. Professional ethical codes for human research provide parameters for making specific ethical decisions. For this project, the ethical issues under consideration were
participants' informed consent, guaranteed confidentiality, and possible consequences of the study for the participants (Kvale, 1996; Marshall \& Rossman, 1995). Each of these issues was addressed prior to the study.

Potential participants in this project were advised of the nature and purpose of the research, in as much detail as possible, so they might make informed decisions regarding their participation. Creswell (1994) and Kvale (1996) recommended that research participants should be educated about the underlying purpose of the project, the primary features of the research design, and any potential risks or advantages related to participation. This information was introduced on the first page of the survey document, and included a statement advising participants that they could decide to withdraw themselves from the project at any time without reprisal. This information page served as the informed consent document, with explanation that clicking on the NEXT button to begin the survey was an indication of consent. Additional signatures of participants' parents / guardians (for students under the age of 18) on student permission slips were collected prior to allowing students to take the survey (Appendix G). When students turned in signed permission slips, they were provided cards containing the URL code so that they could access the survey. By having participants (or their parents / guardians) provide informed consent at the beginning of the survey, the researcher can ensure their voluntary participation and avoid risks of undue persuasion or negative pressure related to taking part in the project (Kvale, 1996). One of the checks and balances of informed consent is the requirement that a research application form be filed with the IRB prior to conducting the project (Creswell, 1994). This Board reviews a description of the study and ensures participants' rights will be protected. Because the data collection period for
this study was longer than expected, three consecutive IRB approvals were obtained (Appendix A).

An additional ethical issue, which can be more difficult to achieve, is ensuring anonymity. As the project examined the aviation / aerospace / engineering career academy or program through data collected from multiple sites, it was difficult to distinguish individual participants through the data description. Kvale (1996) stated that "if a study involves publishing information potentially recognizable to others, the [participants] need to agree to the release of identifiable information" (p. 114). The introduction page included a statement to this effect. In cases where anecdotal responses to survey items (where participants expanded on their response selection) provided an indication of a particular participant's identity, any specific school, program, or geographical identifiers were removed before the comment was discussed.

The final ethical concern is an exploration of potential consequences for participants. As the basis for this project was the investigation into the organizational design factors associated with successful aviation / aerospace / engineering career academies and programs, there appeared to be minimal negative consequences to participation. Kvale (1996) indicated that the benefits for participants and the significance of the research results should outweigh any risk of harm to participants. Due to the anonymity built into an online survey, the potential harm to participants appeared to have been minimized.

## Measurement Instrument

Design of the survey instrument for this study was based on existing survey items for assessing: (a) modern expectancy-value theory as it relates to a program or an
organization, (b) organizational development, (c) high-performance culture, and (d) organizational excellence; and from characteristics presented in articles describing the related theoretical foundation for each of the four constructs.

Constructs. There are a number of common threads in Organizational Development Theory, High Performance Culture Theory, and the Theory of Organizational Excellence. These commonalities facilitated survey item development that address all three quadrants. Existing measurement instruments were reviewed for item content and structure. These included the Organizational Change Capacity and Organizational Performance Survey (Ramezan et al., 2013), the Denison Organizational Culture Survey (Denison \& Neale, 1999), and the Baldrige Excellence Framework for Education (2015). Where a particular attribute for a common construct appeared in survey items from at least two of the three reference measurement instruments, that attribute was developed into an item for this project's survey instrument. The components of the Motivational Theory of Modern Expectancy-Value are different from the other three component theories in the philosophical basis, so there are survey items specific to the elements of this single theory.

Variables and scales. The survey items elicited the level of a participant's agreement with statements about the organizational design of the career academy or program with which they were associated, as well as demographic information. Based on review of survey instruments developed by prior researchers, it was imperative to keep the number of items close to the 25 to 30 range. An additional demographic information page was included in the survey, for use in describing the data when it was collected.

Raw Likert scale data were coded by assigning a number value to each possible response $(1=$ Strongly Disagree, $2=$ Disagree, $3=$ No Opinion, $4=$ Agree, $5=$ Strongly Agree). In addition, the responses for items that were purposefully designed to elicit a negative response were reversed in rank in order to be included in data analysis.

## Data Analysis Approach

Data analysis began with descriptive statistic investigation of survey item responses and qualitative analysis (by survey item) of additional participant comments. This dual-component process was designed to identify survey items that might have anomalous response results. A statistical analysis tested the conceptual model in three steps: an initial EFA to identify factors based on the collected data and make any necessary adjustments to the measurement model where these factors differed from the hypothesized conceptual model; then a CFA step examined the modified measurement model, analyzing relationships between the manifest and latent variables; the final SEM step examined the hypotheses associated with the structural model.

Participant demographics. Potential participants were stakeholders in aviation / aerospace / engineering career education programs with no further restriction for demographic characteristics. Stakeholders included students, parents / guardians, alumni, teachers and coaches, school and program staff, administrators and program leadership, advisory board members, industry members , and mentors. In an effort to increase demographic diversity, invitations to participate were sent to Women in Aviation, International chapters and Black Pilots' Association chapters in every state. Invitations were also sent to the national headquarters for Girls Who Code, the Society of Women

Engineers, the Society of Hispanic Professional Engineers, the Professional Asian Pilots Association, and the Black Engineers Society.

Reliability assessment method. An initial pilot study of the survey instrument was conducted prior to data collection for the formal research, to evaluate the instrument's reliability. It was prudent to perform reliability testing for internal consistency of the instrument again with the sample for the formal research. Reliability testing used Cronbach's alpha for analysis of internal consistency. Tavakol and Dennick (2011) advised that a particular result for alpha is based on results from a specific sample of participants. They suggested that every time an instrument is used, a new Cronbach's alpha should be calculated to examine reliability of the instrument for that particular sample group. Methods used for reliability assessment of model constructs are described in the data analysis process / hypothesis testing section.

Validity assessment method. Survey items were reviewed for validity by an experienced career and technical educator who was employed as a district-level director for career and technical education at the time of this study, to ensure each item was written in language appropriate for the anticipated subgroups. Additional comments by participants in the pilot study of the survey instrument provided subject matter expert advice on modifications that would improve instrument validity. Methods used for validity assessment of model constructs are described in the data analysis process / hypothesis testing section.

Data analysis process/hypothesis testing. Once data were collected and prepared for analysis, responses to each survey item were described. The data were also displayed on bar graphs derived from frequency tables and stacked-bar graphs that
developed a narrative picture of the participants and indicated where there might be significant differences in responses by particular demographic groups. These tables and graphs were included in Appendices C and D. However, due to the small number of participants in some demographic categories, it was not often possible to determine via $X^{2}$ independence testing if differences were significant. Descriptive statistics necessary to verify assumptions for the hypothesis testing procedures, including graphs, numerical statistics, and the related discussion, were included in the narrative.

Exploratory factor analysis. Exploratory factor analysis (EFA) is used in research involving a new measurement instrument, even when the items in the instrument are based on theoretical frameworks developed from the extant literature or items from existing instruments. EFA is a statistical process in which the dimensionality of multivariate data can be reduced, assuming the existence of some underlying common factor model. For this study, the underlying common factor model included constructs associated with organizational design of successful academies or programs; each construct is a common factor for a set of related manifest variables (survey items). The variable successful program was assumed to be the construct for survey items 33 through 35. In a common factor model, the "observed variance in each measure is attributable to a relatively small number of common factors and a single specific factor (unrelated to any other underlying factor in the model)" (Lattin et al., 2003, p. 127).

The purpose of EFA is identifying the common factors and explaining their relationship to the manifest variables. The method involves two major steps: extraction and rotation. The extraction process is commonly accomplished with principal component analysis (PCA). Field (2009) described PCA as a method for "decompos[ing]
the original data [survey items] into a set of linear variates" (p. 638). The focus is on finding linear components within the collected data and estimating how individual survey items would be related to these linear components.

The second step of EFA involves checking to see if the factor analytic solution can be rotated to find the solution with orientation that provides the simplest structure. Factor rotation can be divided into orthogonal and oblique categories. Orthogonal rotations are generally used when the researcher does not expect factors to be correlated while oblique rotations are used for analyses in which the factors are expected to be correlated. Lattin et al. (2003) quoted Comrey (1973) in identifying three steps for selection of the best factor analytic solution:
(1) Most of the loadings on any specific factor (column) should be small (as close to zero as possible), and only a few loadings should be large in absolute value.
(2) A specific row of the loading matrix, containing the loadings of a given variable with each factor, should display nonzero loadings on only one or no more than a few factors.
(3) Any pair of factors (columns) should exhibit different patterns of loadings. Otherwise one could not distinguish the two factors represented by these columns.

These steps are similar to criteria developed by Thurstone (1947):
(1) each row contains at least one zero;
(2) for each column, there are at least as many zeros as there are columns (i.e., factors kept);
(3) for any pair of factors, there are some variables with zero loadings on one factor and large loadings on the other factor;
(4) for any pair of factors, there is a sizable portion of zero loadings; and (5) for any pair of factors, there is only a small number of large loadings (as quoted by Abdi, 2003, p. 2).

It should be noted that zero in these criteria would be defined as between the values of -0.10 and 0.10 (Brown, 2009). When sample size is at least 100 , factor loadings of at least 0.300 are considered significant, and complex variables (associated with criterion (5) above) have loadings of at least 0.300 on more than one factor (Brown, 2009). SPSS Basic software offers three types of orthogonal rotations - Varimax, Quartimax, and Equamax. A Varimax rotation is the most commonly used orthogonal factor rotation; the sum of the variances of the squared factor loadings is maximized which usually results in a small number of factors with high loadings and low factor loadings for all other factors. In other words, the Varimax rotation can be used to achieve the three criteria associated with finding the best set of factors associated with the observed variables. Quartimax rotation is similar to Varimax rotation but tends to produce a single heavily-loaded factor and other less-heavily-loaded factors. Hair et al. (2010) characterized this type of rotation as less effective than the Varimax alternative. They also described Equimax rotation as a "compromise" between Quartimax and Varimax that is not often used (p. 92).

Where orthogonal rotations produce component matrices formatted like an original component matrix using the EFA procedure, oblique rotations generate two matrices: pattern and structure. The pattern matrix depicts weights associated with the
relationships between variable and factor scores. The structure matrix shows the correlations between variables and factors (similar to orthogonal rotation matrices). The Oblimin rotation is the most commonly used oblique rotation. The Promax rotation uses a two-step procedure, beginning with a Varimax rotation and then a Procrustian rotation. A Procrustian rotation involves computation of a least squares fit between the matrix resulting from the Varimax rotation and a target matrix. As the SPSS Basic software can be manipulated quickly to produce all five different rotations (Varimax, Quartimax, Equamax, Direct Oblimin, Promax), Brown (2009) suggested that researchers compare the results for different rotation methods to identify the rotation that best meets Thurstone's (1947) criteria.

The assumptions for EFA include normality, linearity, homoscedasticity, homogeneity of the sample, and conceptual linkages. Hair et al. (2010) described these assumptions as "more conceptual than statistical," explaining that for EFA, "the overriding concerns center as much on the character and composition of the variables included in the analysis as on their statistical qualities" (p. 103). They further argued that some level of multicollinearity would be necessary in identifying interrelated sets of variables. Thus, the primary conceptual issues of concern would be that there is an existing underlying structure for the variables and that the sample is homogeneous with respect to the underlying factor structure. The existence of correlated variables can serve as an initial validation of the first conceptual issue. However, Hair et al. admonished that the researcher must further "ensure that the observed patterns are conceptually valid and appropriate to study with factor analysis" (p. 103). They indicated that an intercorrelation matrix should include a substantial number of correlations greater than
0.30. Hair et al. stated that a Bartlett's test of sphericity with $p$-value $<0.05$ would indicate that "sufficient correlations exist among variables to proceed" (p. 105). Another statistical test to measure intercorrelation is the Kaiser-Meyer-Olkin measure of sampling adequacy (MSA) for which a value of 0.80 or above is considered commendable. It should be noted that MSA values increase when the sample size increases and when the number of variables increases. In addition to validating conditions for using EFA, it was necessary to review sample size guidelines. Given that EFA sample size guidelines suggest a minimum of 10 cases per survey item, the study sample size of 350 would be considered a minimum for the number of variables included.

It should be noted that SPSS Basic software produces EFA results using PCA for factor extraction, which is similar to EFA except it does not rely on an underlying common factor. Upon classification of factors via EFA, modifications were made to the measurement model for the CFA (number of extracted factors was smaller than the number of hypothesized constructs) and then through the CFA, the measurement model was further modified. Related research questions and hypotheses associated with the relationships depicted in the modified model were also adjusted. This modified model and related research questions and hypotheses are presented in Chapter IV. After the measurement model reflected acceptable GoF, modifications were made to the structural model during the SEM phase of analysis.

Measurement model evaluation. This phase of analysis used CFA to verify and confirm the scales derived from the EFA. It also included examination of reliability and validity of the constructs in the hypothesized model and a comparison of model
parameters calculated via the default minimum likelihood method and Bayesian probabilities.

Confirmatory factor analysis. The CFA process involves inspection of the measurement model for goodness-of-fit with the collected data, as well as reliability and validity of underlying constructs. O'Boyle and Williams (2010) suggested scrutinizing the diagnostic information associated with the full model to reduce the number of variables included in a more optimally specified model, based on significance levels associated with parameter estimates (O’Boyle \& Williams, 2010, p. 2). Byrne (2010) provided a graphic to explain the relationship between the two components of SEM (Fig. D1). The CFA component considers only the relationships between manifest variables and latent constructs. Byrne emphasized the importance of using CFA procedures to test the measurement model and modify it where necessary so that it "operate[s] adequately" (Byrne, 2010, p. 164). This evaluation can include modifications to the measurement model based on goodness-of-fit (GoF) indices, lack of significance of regression coefficient estimates, reliability indicators, and validity indicators. AMOS Graphics provides standardized residuals of covariances and modification indices in CFA output. Byrne (2010) and Hair et al. (2010) suggested using these values to modify a measurement model in efforts to improve model reliability and validity and goodness of fit with the collected data. Additionally, error terms can be used to evaluate individual variables. Hair et al. identified an absolute value threshold of 4.0 for determining acceptability of error. Standardized residuals with absolute values greater than 4.0 indicate an unacceptable degree of error while those with values between 2.5 and 4.0
warrant examination, "but may not suggest any changes to the model if no other problems are associated with those two items" (p. 689).

Modification indices reveal possible cross-loadings and relationships that could improve the model fit if included. However, making modifications to the measurement model based on these indices must be tempered by examination of whether such a relationship aligns with the theoretical frameworks upon which the model is based. Hair et al. provided a rule of thumb that no more than $20 \%$ of the manifest variables should be removed from a measurement model through modifications. They suggested that the removal of more than $20 \%$ of the manifest variables might be an indicator that a new model be developed with new data. For this study, $20 \%$ of the manifest variables would be seven survey items.

Goodness of Fit Indices. AMOS Graphics software produces a series of GoF statistics as part of the CFA phase, to analyze the effectiveness of the hypothesized model in explaining the relationships between variables from the sample data. Each set of GoF statistics is calculated for the hypothesized model, a saturated model (one in which the number of estimated parameters is equal to the number of data points), and an independence model (one in which the number of estimated parameters is greater than the number of data points). Byrne (2010) stated that a saturated model would not be empirically interesting because it would have no degrees of freedom, and thus could never be rejected. An independence model is considered under-identified, which Byrne (2010) suggested would not include enough information to determine singular parameter estimates, leading to an infinite number of possible solutions. Thus, the implied goal is to develop an over-identified model, one in which there are more data points than estimable
parameters, yielding positive degrees of freedom and the related capability of being rejected.

Goodness-of-fit indices can be separated into three major categories: absolute fit indices, incremental fit indices, and parsimonious fit indices. Absolute fit indices provide a "direct measure of how well the model reproduces the observed data" through comparison of the researcher's theory (represented by the model) to sample data (p. 648). Incremental fit indices compare the researcher's model to an alternate baseline model, while parsimonious fit indices compare the researcher's model to a set of other competing models, taking model complexity into consideration. Hair et al. (2010) recommended the use of at least one absolute fit index and one incremental fit index. O'Boyle and Williams (2010) recommended using root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR) as absolute fit indices. Hair et al. suggested that values for these indices less than a threshold of 0.07 and 0.08 , respectively, demonstrate goodness of fit when sample size is greater than 250 and there are more than 12 manifest variables (p. 654). Additionally, confidence intervals can be constructed around RMSEA values, offering a range for the degree of precision of the error in the population. According to O'Boyle and Williams, the Comparative Fix Index (CFI) is the best incremental fit index. Hair et al. identified CFI thresholds of 0.92 and 0.90 demonstrating goodness of fit when sample size is greater than 250 and there are 12 to 30 manifest variables or more than 30 manifest variables, respectively. The Parsimony Normed Fit Index (PNFI) appeared to be the best choice of parsimony fit indices because it is less likely to be affected by sample size and model complexity than other indices in this category (Hair et al.). However, Hooper,

Coughlin, and Mullin (2008) argued that parsimony fit indices tend to be influenced by model complexity so PNFI values of at least 0.50 can be considered acceptable when a CFI value is at least 0.90 . Table C 3 includes a more detailed list of additional goodness of fit indices.

Model estimates and estimation procedures. The measurement model was evaluated using maximum likelihood (ML) estimation. Schermelleh-Engel et al. (2003) recognized that this estimation method is the "most widely used fitting function for structural equation models" and is the default estimator for most major software programs (p. 25). They explained that with a sufficiently large sample size, ML produces "asymptotically unbiased, consistent, and efficient" parameter estimates with approximately normal distributions (p. 26). They further noted that multiple studies had shown ML to be "robust against [a] violation of the normality assumption" (p. 26). Additionally, Byrne suggested using Bayesian analysis for CFA and comparing the results to maximum likelihood results. Bayesian analysis is most appropriate for SEM involving categorical variables and does not have a required normality condition. For this study, a Bayesian analysis of the regression coefficients describing relationships between manifest variables and latent constructs was performed and results were compared to the ML results.

Reliability of constructs. Reliability testing examines how stable and consistent the results are when using a particular measurement instrument or analysis method. In addition to examination of the entire survey instrument for reliability using Cronbach's alpha, the reliability of manifest variables in representing underlying constructs was also
investigated. This evaluation involved calculation of construct reliability (also referred to as composite reliability). The formula for this statistic is seen in (1).

$$
\begin{equation*}
\mathrm{CR}=\frac{\left(\sum \lambda_{i}\right)^{2}}{\left(\sum \lambda_{i}\right)^{2}+\left(\sum \epsilon_{i}\right)} \tag{1}
\end{equation*}
$$

where $\lambda$ is the standardized factor loading, and $\epsilon$ is the error variance for each $i$ item associated with a single factor (Raykov, 1997). Hair et al. (2010) stated the rule of thumb that CR values of at least 0.7 "suggest good reliability" while values between 0.6 and 0.7 could be considered acceptable when other factors have values of at least 0.7 .

Validity. Validity testing evaluates how well a measurement instrument or analysis method accurately represents the phenomena being studied. There are multiple validity measures when examining the measurement model. These include construct validity, convergent validity, discriminant validity, nomological validity, and face validity. Hair et al. (2010) described construct validity as the accuracy of manifest variables in representing underlying constructs. This measure is actually the combination of reliability described in the previous section, and the four remaining types of validity. According to Hair et al., convergent validity is the "extent to which indicators of a specific construct converge or share a high proportion of variance in common" (p. 669). It can be evaluated with two measures. First, the researcher should examine the standardized factor loadings; high loadings on a factor indicates convergence. The rule of thumb is that standardized loading estimates should be at least 0.5 (Hair et al., 2010). Additionally, adequate convergence is associated with an average variance extracted (AVE) score of at least 0.5 . The formula for calculation of this statistic is shown in (2).

$$
\begin{equation*}
A V E=\frac{\sum \lambda_{i}^{2}}{n} \tag{2}
\end{equation*}
$$

where $\lambda$ represents the standardized factor loading for each $i$ manifest variable associated with a factor, and $n$ is the number of manifest variables loading on the factor. AVE scores lower than 0.5 indicate there is more unexplained variance for the items associated with a given factor.

Discriminant validity evaluates how distinct an individual construct is from other constructs. Hair et al. (2010) identified a test of discriminant validity that is considered rigorous in which the AVE values for any two constructs are compared to the square of the correlation estimate for the two constructs (maximum shared variance or MSV). It is important to note that the measurement model should include any high cross-loadings in order to consider it a fit model.

Face validity, how well each survey item's intended content or meaning is understood by study subjects, was established a priori via the pilot study through comments by participants on individual survey items regarding perceived meaning of those items. Nomological validity evaluates whether correlations between constructs "make sense" based on the phenomena being studied (Hair et al., 2010, p. 688). The process involves the factor correlation matrix. This evaluation can be accomplished through consideration of the theoretical frameworks combined in the AQAL model (Fig. 4).

Hypothesis testing. According to Kline (1998), the maximum likelihood analysis that underlies SEM assumes multivariate normality of both exogenous and endogenous latent variables. Parameter estimates are generally robust against non-normality, but researchers have three options to circumvent bias if severe non-normality exists (Kline, 1998). These options include: (a) using transformations to normalize the data and then
testing hypotheses with the transformed data; (b) using the original untransformed data with the normal distribution method but calculating corrected tests statistics; or (c) using an estimation method that does not require normality. Nevill and Lane (2007) argued against using log transformations for Likert scale data as this type of transformation is "only appropriate for true ratio scale data" (p.1). This reasoning would also refute application of other mathematical processes such as square-root or inverse transformations. Bayesian estimation does not require normality, and it was used as a comparison technique to validate the regression coefficients produced via maximum likelihood estimation. Most importantly, corrected test statistics include rescaled GoF indices and robust standard errors (Kline, 1998) that are provided in the SEM output from the SPSS AMOS Graphics software (Byrne, 2010). The large sample size and robustness of certain GoF indices offered some relief from a concern about normality.

The second phase of data analysis was accomplished with structural equation modeling (SEM). The initial hypothesized structural model addressed the research questions; the modified model based on EFA results addressed the modified research questions. Evaluation of the structural model involved examination of the estimated regression coefficients for endogenous and exogenous variable relationships to determine significance levels. Regression coefficients with $p$-values of 0.05 or less were considered significant, while those with $p$-values greater than 0.05 were considered not significant and were removed from the model. After these modifications were made to the model, the GoF indices ( $X^{2}$, CFI, RMSEA, SRMR, PNFI) were reviewed and compared to their values for the measurement model. Additional modification indices for possible relationships between latent constructs were reviewed for any further changes to the
model in a post hoc analysis. Byrne (2010) admonished that making modifications to the structural model in post hoc analysis would likely yield smaller and smaller returns (in the form of incremental improvements to $X^{2}$, CFI, RMSEA, and SRMR, PNFI), and that researchers should refrain from continuing to modify a model for minimal return.

Qualitative data analysis process. Each survey item included an open-ended box for participants to add comments. Often, even though these types of comments may be considered anecdotal, they enrich the narrative and enable deeper understanding of the constructs being studied. When participants provided additional comments, they were examined for patterns that may be of interest. These patterns were discussed as part of the descriptive statistics subsection for each individual survey item.

## Summary

A mixed-methods approach to data analysis, involving both statistical analysis of Likert-scale survey items and qualitative examination of additional comments made by study participants, allowed for a more comprehensive understanding of the information provided by the participants. Initial examination of survey item responses included examination of frequency tables, bar graphs, and stacked-bar graphs, allowing for recognition of any survey items that might prove problematic in further data analysis and hypothesis testing phases. EFA was used to check relationships that were estimated in the initial conceptual model. A subsequent CFA was used to evaluate the measurement model that incorporated modifications based on the EFA. After further refinement of the measurement model, SEM was used to analyze the structural model, and a subsequent post hoc analysis was conducted to investigate the possibility of generating a betterfitting model for the data. The SEM and post hoc analyses led to evaluation of
hypotheses and answering research questions. The qualitative analysis involved examining trends in participant comments by survey item and underlying themes across multiple items.

## CHAPTER IV

## RESULTS

## Pilot Study

A pilot study of 38 potential survey items was conducted from September through December of 2015, with the dual purpose of collecting data for reliability and validity analysis of the items and using that analysis to determine which items could be eliminated from the final version of the survey. The survey was administered to population subgroups similar to the intended population for the dissertation study. However, in an effort to expedite the pilot study process and Institutional Research Board (IRB) approvals, only adult subgroups were included. Because there is a limited number of aviation / aerospace / engineering career academies, the survey items were written in a generic form so that pilot testing could be accomplished with participants from careeroriented programs in other disciplines. When possible, stakeholders in academies that have earned NCAC National Model or NAF Distinguished Academy status were invited to participate. Thirty-three individuals took the online survey; 31 completed the survey, while two surveys were incomplete.

Statistical testing was used to examine the internal consistency reliability of the survey, the level to which all items designed to measure a particular concept or construct are inter-related and test what they are designed to test. Cronbach's alpha is very widely used as an objective measure of reliability because it can be used with only one administration of an instrument, and the instrument can include "multiple-item measures of a concept or construct" (Tavakol \& Dennick, 2011, p. 53). The Cronbach's alpha analysis of the entire survey yielded a result of 0.955 . This value for alpha is considered
excellent ( $>0.70$ ). However, Tavakol and Dennick (2011) cautioned that high values for alpha may be a product of the length of the instrument rather than due to a high degree of internal consistency, and they warned that an extremely high alpha level may indicate redundancy of individual survey items. They suggested that if an instrument is designed to measure multiple concepts or constructs, it is necessary to calculate alpha for each concept or construct. Though the constructs included in the design of the survey for this research are all related to success or excellence of the organization, separate coefficient alphas were calculated and are shown in Table 3. Acceptable values for alpha are generally considered to be between 0.70 and 0.95 (Tavakol \& Dennick, 2011). Values in the 0.60 to 0.69 range are considered questionable, while values from 0.50 to 0.59 are considered poor (Gliem \& Gliem, 2003). Hair et al. (2010) cited a 1991 text by Robinson et al. indicating that when performing exploratory research, the lower limit for acceptability can decrease to 0.60 . Development of a new measurement instrument would be considered exploratory research. However, Tavakol and Dennick noted that low values for alpha can be the result of a low number of questions; none of the individual constructs had more than five questions. Additionally, lower coefficient alphas may also be the result of a wider variety of disciplines for the pilot study sampling frame. Individuals associated with successful career academies and career education programs included disciplines from cosmetology and the arts to auto maintenance, law, and video production. Further statistical analysis included Spearman's rho correlation analysis for survey items assigned to specific constructs. This method examines the association of ranks of responses (so Likert scale responses can be coded with a rank order), without requiring linearity or normality associated with correlation considerations.

Although the Cronbach's alpha value for Motivation was lower than desired, it should be noted that this construct was only assigned three survey items. There was an expectation that this construct might show somewhat different results than the rest of the constructs, based on its theoretical basis being different from the other three organizational theories used in the model based on combined theoretical frameworks.

Table 3
Cronbach's Alpha Values for Individual Constructs

| Construct | Number of <br> Cases | Cronbach's <br> alpha | Number of <br> Items |
| :--- | :---: | :---: | :---: |
| Motivation | 32 | 0.631 | 3 |
| Vision / Alignment | 31 | 0.521 | 5 |
| Leadership / Accountability | 29 | 0.685 | 5 |
| Communication / Information | 30 | 0.726 | 5 |
| Teamwork / Collaborative |  |  |  |
| $\quad$Environment | 30 | 0.690 | 5 |
| Resources <br> Learning | 29 | 0.865 | 5 |
| Flexibility / Continuous <br> $\quad$ Improvement | 30 | 0.667 | 5 |

Note. The number of cases differ for constructs due to skipped items by individual respondents.

The Cronbach's alpha value for the Vision / Alignment construct (0.521) was much lower than desired, warranting an examination of the survey items associated with this construct. Using a Spearman's rho correlation for the items assigned to this construct, correlation coefficients for the items indicated that one item (I believe my personal goals and expectations - related to my academy - are aligned with the vision statement.) did not have a significant correlation with any of the other items for Vision / Alignment. The $p$-values for a two-tailed test of correlation with each of the other items
were $0.772,0.767,0.999$, and 0.280 . When this item was removed, the Cronbach's alpha for the remaining four survey items was 0.620 , which falls within the acceptable range for exploratory research.

A similar analysis was performed for the Leadership / Accountability survey items. One item (I rarely have the opportunity to interact with leaders - students and / or adults - of my academy.) did not have any significant correlations with the other four items for this construct. The $p$-values for a two-tailed test of correlation with each of the other items were $0.406,0.601,0.602$, and 0.380 . When this item was removed, the Cronbach's alpha for the remaining four survey items was 0.800 .

The Teamwork survey items were examined for correlation, and one item (I do not always feel free to express my ideas in my academy because I worry about being judged or having negative consequences.) only showed a mildly significant ( $p=0.41$ ) association with one other item in the group (We use teamwork to get work done in my academy.). When the item (I do not ...) was excluded from the group, the Cronbach's alpha for Teamwork was 0.745 .

The Learning survey items were similarly examined for correlation, and one item (By participating in my academy, I learn more than I expected to know.) did not show any significant correlation with the other items for this construct ( $p$-values of 0.085, $0.620,0.618$, and 0.141 ). When the item was excluded from the group, the Cronbach's alpha for Learning was 0.712 .

When the Flexibility / Continuous Improvement survey items were examined for correlation, two items (There is too much red tape associated with my academy to make changes, and, In my academy we are rarely challenged to extend or expand what the
academy can do.) showed no significant correlations with the other items for this construct (respective $p$-values of $0.341,0.359,0.129$, and 0.091 ; and $0.507,0.452,0.091$, and 0.336). Removing both of these items from the group resulted in the Cronbach's alpha for Flexibility / Continuous Improvement of 0.846.

Further statistical analysis of the overall instrument with the aforementioned items removed for each of the specified constructs resulted in an instrument Cronbach's alpha of 0.962 . The modified instrument comprised 32 survey items, including items written as positive comments as well as items written as negative comments. Although this number of items was slightly more than the original target number of 20 to 30 , a 32-item instrument should not make the survey process too cumbersome for participants.

Additionally, pilot study participants were offered the opportunity to comment on each survey item, and they were asked to identify any items they believed might need to be revised or re-worded. Most of the respondents' comments were related to their actual response choices. However, comments regarding some survey items indicated a need to revise their wording. One respondent, who self-described as a university administrator with more than 40 years of experience and advanced degrees in the field of education, provided specific advice regarding the wording of some of the items. Items that were identified as poorly or questionably worded are shown in Table 4.

Revisions to the items in Table 4 included changing the phrase "certain groups of people to there are specific groups of people (e.g., seniors who have been in the academy for four years, or math teachers) who," deleting the words "interpret and" from the second item shown so that it only applies to understanding disseminated information, and
changing the phrase "learn more about the work or knowledge to learn more careerrelated knowledge."

## Table 4

Survey Items Identified for Revision

## Item

In my academy certain groups of people have better access to information we all need.

The way information is presented for my academy makes it difficult to interpret and understand.

I believe I can learn more about the work or knowledge associated with my academy outside the academy than by participating in it.

## Comment

I am not sure what you mean by certain groups of people.

Two different constructs. I don't understand what the question is asking - information about what, and to whom?

Dual constructs. This question is confusing. What are you getting at?

## Demographics Results

An initial inspection of the data collected in survey responses from participants revealed that some participants chose not to respond to as many as three survey items. Also, some participants chose not to complete demographic items. If a participant left one or more of the survey items blank, their response was eliminated from use for hypothesis testing. However, if the only items a participant left blank were demographic items, their responses to the survey items were used for hypothesis testing, and the demographic information they did provide was used in the descriptive statistics section. All additional comments made by participants, regardless of their completion rate for survey items or demographic items, were used in the qualitative analysis. On detailed
examination of the data, it was apparent that one participant chose the response strongly disagree for every item, implying that they did not read the items carefully. This participant was a student, and the demographic information provided - especially with respect to GPA - did not align with all other student participants. Though it is possible that this was a very low-performing student, the more likely scenario was that the individual did not take the survey seriously. All data from this participant were eliminated.

Responses to demographic questions at the end of the survey were examined via frequency tables, bar graphs, and $X^{2}$ testing for independence to identify significant differences between subgroups that might influence findings from the hypothesis testing. Some demographic items were only accessible by those participants who self-identified as students while other items were only accessible by those who self-identified as members of one of the adult categories, resulting in total frequencies less than the total number of participants in the study. One participant chose not to answer any of the demographic questions (but did complete the survey instrument items). This participant was not included in the calculation of percentages that are reported in this narrative discussing the sample. Additionally, some of the student respondents did not answer questions about their grade point averages or years in their respective programs, while some of the adult respondents did not answer questions about household income or hours devoted to their respective programs. These omissions could account for gaps in the collected data categories.

There were 349 responses to the gender question, with 208 respondents selfidentifying as male and 141 respondents self-identifying as female, or a $59.6 \%$ to $40.4 \%$
split (Table C4 and Fig. D3). These proportions do not mirror gender makeup within the fields of aviation, aerospace, or engineering, but may be explained by the inclusion of educators and parents as survey participants.

There were 349 responses to the race question, with 268 of respondents selfidentifying as White or Caucasian, accounting for $76.8 \%$ of the sample (Table C4 and Fig. D3). Thirty-six respondents self-identified as Black or African American, which was $10.3 \%$ of the sample. The remaining $12.9 \%$ of the sample was comprised of 18 Hispanic participants, 12 Asian or Pacific Islander participants, 3 American Indian or Alaskan Native participants, and 12 participants who self-identified as having Multiple Ethnicities or being Other.

The third demographic question asked participants to identify their role as associated with their respective academy / program; 349 participants responded to this question (Table C4 and Fig. D3). The largest subgroup self-identified as Students (111 participants for $31.8 \%$ of the sample), but the subgroup of CTE teachers had similar numbers (102 participants for $29.2 \%$ of the sample). The Students category included school-based academy / program participants as well as participants in community programs such as the Civil Air Patrol. The CTE teachers category comprised schoolbased academy / program instructor (including JROTC and advisors for Technical Student Association or SkillsUSA extracurricular groups) and community-based program coaches or instructors (including the Civil Air Patrol and the Black Pilots Association). Sixty-seven participants, comprising $19.2 \%$ of the sample, self-identified in other schoolbased or community-based staff roles: $14.6 \%$ administrators, $2.6 \%$ core content teachers, $2 \%$ school staff. Core content includes language arts, mathematics, science, and social
studies. Twenty-five academy / program alumni accounted for $7.2 \%$ of the sample, and 14 parents or guardians accounted for $4 \%$ of the sample. Adults involved from external sources who participated in the survey included 13 advisory board members ( $3.7 \%$ of the sample), 15 industry members or program mentors ( $4.3 \%$ of the sample), and two participants who self-identified as other but did not provide specific details ( $0.6 \%$ of the sample).

Four demographic questions focused solely on participants who self-identified as students. Of the 111 student participants, 103 answered the question on grade level (Table C4 and Fig. D3). It is possible that the eight remaining student participants may have already graduated from high school but self-identified as students due to their level within a community-based program. The largest group of students comprised 46 juniors for $44.7 \%$ of the 103 students who answered this question. Twenty-four seniors comprised $23.3 \%$ of the group; 21 sophomores made up $20.4 \%$ of the group, and 12 freshmen comprised $11.7 \%$ of the group. It is not surprising that the upperclassmen (juniors and seniors) comprised a larger proportion (68\%) of the group. At the high school level, some programs see an increase in student interest by sophomores, juniors, and seniors who learn about these programs during a school year and choose to become involved in the following school year.

A second question for students asked them to report the number of years they had been involved with their academy / program, and there were 106 responses (Table C4 and Fig. D4). Thirty-eight students, comprising the largest proportion (35.8\%) of the students who responded to this question, reported that they had been involved with their academy / program for less than one year. Another 33 students, comprising $31.1 \%$ of those who
responded, reported being involved for at least three but less than four years. Of note is the fact that more than $50 \%$ of the students who responded to this question had been involved with their academy or program for at least two years, which may suggest at least some level of satisfaction with a perceived return on investment. It is also interesting that 12 students, or $11.3 \%$, reported at least four years of involvement. These would likely be students involved with a Technical Student Association, SkillsUSA, or one of the community-based programs such as Civil Air Patrol. These organizations include middle-school age students as well as high-school age students.

Two questions for students addressed estimated grade-point averages (GPAs). The first question asked about students' estimated cumulative high school GPAs, and there were 105 responses (Table C3 and Fig. D4). Ninety students, comprising $85.7 \%$ of the respondents, reported GPAs of at least a 3.00 on a 4.00 or weighted 5.00 scale. Of that group, 25 students ( $23.6 \%$ of the total respondents) reported GPAs of at least a 4.00 . No students reported a GPA of less than 2.00. A 2013 ACTE study found that students involved in career academies or programs tend to have GPAs in the higher range.

A second question asked students for their estimated GPAs in the career academy/ program in which they were involved. There were 104 responses (Table C3 and Fig. D4). The proportion of students reporting a career education GPA of at least a 3.00 was 94.2\% (88 student respondents), indicating that for some students, their career education GPA helps their cumulative GPA. Thirty-three students (31.7\%) reported a career education GPA of at least a 4.00. It should be noted that, in some states, advanced-level courses in career education are weighted in the same manner as honors-level academic
core courses. As with the cumulative GPA question, no students reported a career education GPA of less than 2.00.

There were two questions for adult survey participants. The first of these questions asked for estimated household income; 198 of the adult participants responded to this question (Table C3 and Fig. D4). Ninety adult participants (45.4\% of the respondents) reported household income between $\$ 75,000$ and $\$ 124,999$ - with an equal split between the $\$ 75,000$ to $\$ 99,999$ and $\$ 100,000$ to $\$ 124,999$ categories. Another 50 adult participants $(25.2 \%)$ reported household incomes between $\$ 125,000$ and $\$ 174,999$ with an equal split between the $\$ 125,000$ to $\$ 149,999$ and $\$ 150,000$ to $\$ 174,999$ categories. Of note is that there were no adult participants who reported incomes between $\$ 25,000$ and $\$ 49,999$. The wide range of reported household income levels (from the $\$ 0$ to $\$ 24,999$ category through the $\$ 200,000$ and higher category) indicates an interest level in involvement with career education programs across socio-economic status.

The second question for adult participants asked about their time commitment to their academy or program; 223 participants responded (Table C3 and Fig. D5). Fiftyeight respondents, comprising $26 \%$ of the total, reported involvement of at least ten hours per week. This was the largest group of respondents to this question. Another 49 participants (22\%) responded that they were career / technical education teachers, instructors, or coaches in their academy / program - indicating their participation level exceeds ten hours per week. Forty-seven participants (21.1\%) reported devoting at least two but less than five hours per week. It is interesting to note that 107 respondents,
almost half of the adult participants who responded to this question, devote at least ten hours per week to their academy / program.

Two-way tables were generated to investigate independence of the categorical demographic variables. One of the conditions required to perform $X^{2}$ analysis for independence of variables is for each cell in a two-way table to include a count of at least five, or for no more than $20 \%$ of the cells to include an expected count of less than five. Only three cases (Gender and Student Grade Level, Gender and Student Estimated High school GPA, and Gender and Adult Estimated Hours for Program) met this condition (Table C5 includes $X^{2}$ results for all combinations of variables). For each of these cases, the resulting $X^{2}$ and $p$-values $\left(X^{2}=0.363, p\right.$-value $=0.948, X^{2}=4.939, p$-value $=0.085$, $X^{2}=6.314, p$-value $=0.177$, respectively indicated that the paired variables under consideration were independent).

## Descriptive Statistics

Responses to each survey item were organized into frequency tables for examination, along with related bar graphs. Frequency tables and bar graphs showing overall responses are included in appendices C and D. Stacked bar graphs disaggregated by demographic characteristics are included in appendix D. Colors in the stacked bar graphs were reversed for negatively worded items so that negative responses to the survey item would correspond to positive impressions of the participants' academies or programs. In this manner, the reviewer can examine these graphics for general response across all survey items. Rather than detailed descriptions of each of the stacked bar graphs, this narrative includes a general impression of the responses of different groups based on bands of color. Many of the disaggregated categories included very small
numbers of participants making it difficult to compare percentage bands across a demographic variable.

For most of the survey items, $X^{2}$ testing for independence was not appropriate because there were too few responses in some of the categories to meet the two-way table cell minimum expected size condition. Where the variety of responses was more diverse, $X^{2}$ testing was performed. Qualitative analysis was performed on the participant comments for each survey item as well. SurveyMonkey.com provided a graphic of words repeated at least three times in participant comments. For each survey item, qualitative analysis included a frequency table for words that were not in the item itself. Item 1. I believe that I can be successful as a participant in and / or contributor to my academy / program.

The most frequent response to this item was agree with approximately $48 \%$ of participants (Table C6 and Fig. D6); almost the same proportion responded strongly agree (approximately 47\%) for a total of $94.6 \%$ of respondents showing agreement with the item. Only six of 350 respondents disagreed with the item statement. Stacked bar graphs for responses disaggregated by demographic characteristics indicated little disparity across subgroups (Figs. D6 and D7). This phenomenon was expected because of the $94.6 \%$ overall majority strongly agree and agree response rate. The orange color band, representing agree responses, appeared predominant across most disaggregated groups with some subgroups having a higher proportion of yellow, representing strongly agree. Some subgroups appeared to have a wider variation (i.e., American Indian or Alaskan Native in Fig. D6), but this phenomenon was likely due to the small number of subgroup members rather than a significant difference from the rest of the sample. One
key point was that the only disagreement with the item came from school-based participants (students, CTE teachers and program instructors, core content teachers, and school or program staff). The largest of these subgroups, the students also showed an interesting trend that as estimated high school GPA increased or CTE GPA increased, there was a decrease in negative responses. It was also interesting that a higher proportion of negative responses occurred from students in later years of their academies or programs.

Eleven participants added comments to their responses to this item. There were no words common to at least three of the participant comments for this survey item. The predominantly positive comments ( $64 \%$ ) focused on the participant's level of effort as a direct indicator of success, from a very general "You get out what you put into life," to a parent's comment that their child "uses the program to follow her own passion" and an alumnus indicating he would be interested in returning to his high school program to coach a TSA program. Negative comments focused on perceived constraints related to program leaders or management outside the school / community.

Item 2. I believe my effort/participation level with respect to my academy / program directly affects how well I achieve my expectations.

The most frequent response to this item was agree with approximately $47 \%$ of participants (Table C6 and Fig. D8); almost the same proportion responded strongly agree (approximately $42 \%$ ) for a total of $89.6 \%$ of respondents showing agreement with the item. Less than $3 \%$ of respondents disagreed with the item statement, and there were no strongly disagree responses. Stacked bar graphs for this item reflected slightly more difference in response proportions in some of the demographic questions, even though no
participants chose strongly disagree (Figs. D8 and D9). Across most subgroups, orange (agree) was again the most predominant, with yellow (strongly agree) also very common, which was expected based on the relative sizes of the bars in the graph of responses for the entire sample (Fig. D8). One phenomenon that stood out was the completely green (no opinion) bar for those who self-identified as filling some other role with their academy / program. However, this group was very small. Within the student subgroup, proportions of agreement increased as high school GPA increased, and there was more disagreement from students in later years of their academies / programs.

Six participants provided additional comments associated with their responses to this item. There were no words common to at least three of the comments. Five of the six comments were positive, including "...you get out what you put in," "I believe it," and "I just have to be true to myself." The only negative comment indicated that the participant believed individuals associated with the community-based program from another unit had more control over activities.

Item 3. I believe that participating in and / or contributing to my academy / program is a valuable experience (with respect to my personal goals).

The most frequent response to this item was strongly agree comprising almost $60 \%$ of participants (Table C6 and Fig. D10). Over $96 \%$ of participants selected either agree or strongly agree, indicating a very positive belief about individual participation and / or contribution. Only one respondent disagreed with the statement, and no respondents selected strongly disagree. An examination of the stacked bar graphs (Figs. D10 and D11) showed a general consensus across most subgroups that they strongly agree with the item as yellow was the predominant color band in most graphs. There was
a wider variety of responses in some of the smaller subgroups (American Indian or Alaskan Native, school staff). The only disagreement occurred in student subgroups juniors and students with between three and four years in their programs. It should be noted that as estimated high school GPA increased, level of agreement with this item increased.

The graphic for most repeated words in participant comments showed the most commonly repeated word was skill with more than $18 \%$ of respondents who wrote comments using this term (Fig. D11 and Table C7). Adults who used this word discussed the variety of skills associated with aviation / aerospace / engineering and drawing personal satisfaction from knowing their efforts would benefit students and, by extension the industry, in the future. Students and alumni commented on the value of the skills they were building via participation in their respective academies / programs toward their future earning power.

Positive comments for all groups focused on personal growth as aviation / aerospace / engineering pre-professionals and professionals, instructors and mentors, and with respect to life skills developed via extracurricular activities such as TSA. The only negative comment, that the individual had not been allowed to pursue personal growth, indicated a different interpretation of the survey item as most comments reflected an interpretation of goals as self-regulated rather than externally by the academy / program. Item 4. Decisions about my academy / program are aligned with the vision statement. The most frequent response to this item was agree with approximately $53 \%$ of participants (Table C6 and Fig. D12). Additionally, almost 28\% responded strongly agree for a total of $90.8 \%$ or respondents showing agreement with the item.

Though $14 \%$ of respondents had no opinion, there was very little disagreement with the item. Slightly less than $5 \%$ of respondents chose disagree, and less than $1 \%$ chose strongly disagree. Examination of the stacked bar graphs (Figs. D12 and D13) revealed a predominant orange band (agree) across most subgroups; there was slightly more variability in some subgroup bars. There were visible blue (strongly disagree) and magenta (disagree) bars in several of the subgroups, though these bands were most obvious in the smaller subgroups. There also appeared to be a wider use of the no opinion option for responding to this item.

Ten participants added comments to the responses to this item. There were no words common to at least three of the ten responses. There were more positive than negative comments ( $40 \%$ compared to $20 \%$ ). The remaining four comments included remarks about understanding the item itself as well as an observation that described both positive and negative aspects of the participant's program. In general, the positive comments reflected localized decision-making by individuals directly involved with a specific program and site versus negative comments identifying influences from outside the specific program.

Item 5R. Daily activities / processes within my academy / program are not aligned with the vision statement.

Data for this item were reversed for hypothesis testing purposes because the statement is a negative statement. However, for descriptive analysis, actual participant responses were examined. The most common response was disagree with more than $48 \%$ of respondents indicating that daily activities and processes did not align with the vision statement for their academy / program (Table C6 and Fig. D14). An additional 15\% of
respondents chose strongly disagree, resulting in a majority (64.2\%) of respondents showing a negative opinion about the alignment of daily activities and the vision statement for their academy / program. It should be noted that more than $18 \%$ of respondents indicated a positive opinion and more than $18 \%$ responded with no opinion. The stacked bar graphs (Figs. D14 and D15) reflected a greater variability of responses across some subgroups, especially with respect to race and within the student subgroups, as evidenced by the relative sizes of color blocks in bars that represented both large and small subgroups. In the overall graphs for gender and role within the academy / program, orange (disagree with the negative item - reflects a positive feeling toward the academy / program) was the predominant color band. However, when separating students and adults, one can see that there was a higher proportion of negative responses (agree or strongly agree) toward this item across the student subgroups.

There were 17 comments from participants, with four words or phrases that had a frequency of three. Two of these, align and vision statement, were in the item itself. The common term, one (frequency $=3,17.65 \%$ ), was used both as a numerical quantifier (i.e., "one class") and referring to an individual. The common term, everything (frequency = $3,17.65 \%$ ), was used in two positive comments, "Everything we do on a daily basis is focused on the vision statement" and "Almost everything is aligned with the end goal...," but also in one negative comment, "Everything else takes priority." There were eight positive comments compared to four negative comments, with the remaining comments appearing as questions or including both positive and negative opinions. The positive comments reflected academies / programs with a focus on results in setting priorities that aligned with the vision statement. Negative comments indicated that activities
(sometimes too often) included administrative responsibilities that the participants viewed as impeding a focus on the organization's vision.

Item 6. There is a system in place to measure my academy's / program's progress according to our vision statement.

The most frequent response to this item was agree with approximately $48 \%$ of participants (Table C6 and Fig. D16). Almost the same proportions of participants responded no opinion (17.7\%) and strongly agree (18.9\%). The majority of participants chose positive (agreement) responses (66.6\%) while only $15.7 \%$ of participants chose negative responses ( $14.6 \%$ disagree and $1.1 \%$ strongly disagree). The stacked bar graphs (Figs. D16 an D17) showed orange (agree) or a combination of orange and yellow (strongly agree) as having the greatest proportions of responses. However, there was more variety of responses in several subgroups, and this phenomenon was equally noticeable in the student and adult subgroups - although the adult subgroups seemed to exhibit higher proportions of overall agreement.

Twenty-two participants added comments for this item. The word track was used in three of the 22 comments (13.65\%) with additional repetition of the words program and progress that were in the item itself. Track was included in one generally positive comment that identified industry certification as the only program metric. It also appeared in two negative comments. One was from a program alumnus who was unaware of any specific tracking program, while the other provided insight into an issue that may warrant more investigation, "The district does not track student progress after they leave the program, so the only evidence is anecdotal." There were only four negative comments compared to twelve positive remarks and five comments indicating
that the participant was not certain of possible accountability systems. Most of the comments - positive and negative - addressed metrics that were being used. These included students graduating their programs with honors, industry certifications, unit inspections, annual reporting, and individual program metrics. There was a concern that a school had implemented a more general methodology related to standards-based lesson planning that the participant believed was not directly aligned with their academy vision statement.

Item 7. The things I participate in that are related to my academy / program seem to be aligned with the vision statement.

The most frequent response to this item was agree with a majority of participants (approximately 53\%) selecting this option (Table C6 and Fig. D18). A slightly smaller proportion responded strongly agree (approximately $34 \%$ ) for a total of $86.6 \%$ of participants showing agreement with the item. Less than $1.5 \%$ of participants disagreed with the item statement, and there were no strongly disagree responses. Orange (agree) was the predominant color band across almost all subgroups in the stacked bar graphs (Figs. D18 and D19). In the only case where orange was not present, a small subgroup in estimated household income, the responses were all yellow (strongly agree). The green (no opinion) color bands did not seem to show any significant trend for subgroups, and there was minimal disagreement among both students and adults. Only juniors and students with between three and four years in their academy / program showed any disagreement.

There were six comments by participants related to this survey item, but no words were repeated at least three times. Four of the six comments were positive and simply
reflected the participants' agreement with the statement. One comment was unusable, and the final comment included both positive and negative output in a "sometimes yes, sometimes no" statement.

Item 8. Leaders (students and / or adults) help everyone work to achieve the goals and objectives of my academy / program.

The most frequent response to this item was agree with a majority of approximately $53 \%$ of participants (Table C6 and Fig. D20). A slightly smaller proportion responded strongly agree (approximately $35 \%$ ) for a total of $87.7 \%$ of participants showing agreement with the item. Only $6 \%$ of participants responded that they disagreed with the item, and there were no strongly disagree responses. The remaining $6.3 \%$ of responses were no opinion. Across all subgroups in the stacked bar graphs (Figs. D20 and D21), the predominant color band was orange (agree) or a combination of orange and yellow (strongly agree). The only exception was one adult subgroup in estimated household income that was entirely yellow. There was some disagreement that spread across some subgroups. Within the student graphs, it was interesting to note that disagreement was expressed by juniors and seniors and students with less than one year or at least three years in their academies / programs. This combination indicated that some academies / programs must be recruiting (or accepting) upperclassmen into programs. Though a phenomenon not investigated in this research project, such recruitment / acceptance is an encouraging sign for expanding the employment pipeline. However, the disagreement with the survey item indicated that academies / programs may need to review how they integrate these older students.

There were 21 comments for this item. Four of the five most common words were included in the item, but the word "others" appeared in three of the comments (14.29\%). This word occurred in one negative comment indicating a lack of support for individual stakeholders developing new programs or activities. It also was included in two comments that some leaders were more helpful than others. There were eight positive comments compared to seven negative comments with the remaining remarks being both positive and negative or unusable. The positive opinions described leadership across multiple levels of the academy / program, including "Pretty nearly every student in the program taking it seriously found it in themselves to have some leadership qualities." This caveat associated with participation level, motivation, or effort occurred in both positive and negative comments. Negative comments indicated participants' opinions that at least some of their leaders followed personal agendas that might not completely align with organization goals and objectives.

Item 9. Leaders (students and / or adults) regularly interact with members of my academy / program to involve us in planning and decisions.

Agree was the most frequent response for this item, with a majority of more than $51 \%$ of the participants (Table C6 and Fig. D22). Slightly less than half of this proportion (approximately 20\%) responded strongly agree for a total of $71.7 \%$ of participants showing agreement with the item. Slightly more than $12 \%$ of participants disagreed with the item, and an additional $1.4 \%$ responded strongly disagree. The remaining $14.6 \%$ of responses were no opinion. Examining the stacked bar graphs (Figs. D22 and D23) indicated that orange (agree) was a predominant feature in most subgroups. It was least visible in smaller subgroups
where there was a higher proportion of green (no opinion) or a combination of green, magenta (disagree), and / or blue (strongly disagree). There appeared to be a higher proportion of yellow (strongly agree) across student groups than adult subgroups. It was interesting to note that the only blue bands appeared in male and adult (alumni, CTE teachers, and advisory board / program mentors) subgroups.

There were 21 comments from participants with four common words, only one of which (members) was included in the item (Table C7). The word "work" was the most common term, occurring in four responses (19.05\%), three of which were positive while one was a more neutral "Work in progress." The word "making" appeared in comments that described decision making: a positive remark about collaborative efforts and an opinion that it was difficult to get feedback from organization members that could be used in making decisions. All three participants who included the word "sometimes" in their comments used it as an indicator of a neutral position. There were ten positive comments and four negative remarks, with the rest reflecting a neutral position for organizations that the participants believed had some leadership interaction but that it was inconsistent. The positive comments indicated focused effort by leaders to establish channels for communication across a broad spectrum of stakeholders, while negative remarks reflected a perceived lack of commitment or interest in involving all stakeholder subgroups.

Item 10. Everyone involved with my academy / program (students and / or adults) is expected to contribute to the academy's / program's success.

The most frequent response to this item was strongly agree with approximately $47 \%$ of participants (Table C6 and Fig. D24). Almost the same proportion responded agree (approximately $43 \%$ ) for a total of $90.3 \%$ of participants showing agreement with the item. Just $4 \%$ of participants disagreed with the item, and fewer than $1 \%$ responded strongly disagree. The remaining $5.1 \%$ of participants responded with no opinion. The stacked bar graphs reflected the overall positive responses to this item with large yellow (strongly agree) and orange (agree) color bands across all subgroups (Figs. D24 and D25). Disagreement (magenta for disagree) within student subgroups was limited to juniors, though they were divided across multiple subgroups for years in the academy / program. The only blue (strongly disagree) bands were in adult subgroups, though disagreement (magenta or blue) was spread across adult subgroups.

There were several repeated words and phrases in the 26 comments by participants (Fig. D25 and Table C7). Although three of the terms were included in the item, ten repeated words were further examined. The word "work" occurred in five comments (18.52\%). The positive references included two statements about students, "do[ing] their part and thriv[ing] if they have natural talent, an ability to learn and a willingness to work," and how a class had "already worked to exceed the expectations given." Two remarks were neutral, while the negative comment addressed motivation, "Between the expectation and the reality, falls the shadow. Ten percent of the members do $90 \%$ of the work necessary...." Comments about students (18.52\%) referenced academy / program metrics and efforts by organizations to help students participate in career-related events and conferences,
provide feedback for their academies / programs, and "achieve more than they ever thought they would." The word "always" appeared in four comments (14.81\%), and in each of these cases, it was used as a quantifier for what the participant believed was not occurring in their academy / program. Seven terms, "participate, volunteer, yes, level, part, end, and members" were each repeated three times (11.11\%) across different comments. Positive responses included the suggestion that "success only happens when all participants are constructively engaged and committed" and "everyone is expected to play a part." One stakeholder believed that the only way their academy "stays alive is if people are earning industry certification ... every student is expected to try and earn some certification and teachers teach the [related] material ... to the best of their ability." Negative comments included "I don't think the expectation of participation was set" and that results vary with volunteer stakeholders.

Item 11. When someone involved with my academy / program (students and / or adults) does not meet their responsibilities, they know they will be held accountable.

Agree was the most common response to this item with $46 \%$ of participants (Table C6 and Fig. D26). Almost 15\% responded strongly agree for a slim majority of $50.6 \%$ showing a positive reaction to the item. The same proportion of participants (19\%) responded that they disagreed or had no opinion while approximately $1.7 \%$ chose strongly disagree. The wider variability in responses was reflected across subgroups in the stack bar graphs (Figs. D26 and D27). Orange (agree) was still a predominant color band across most subgroups, and magenta (disagree) and blue (strongly disagree) color bands were most
noticeable in smaller subgroups. However, it is important to note that the only blue band in the graph for race was in the White / Caucasian subgroup which was the largest subgroup for this variable. Though there was evidence of disagreement across all student subgroups, only sophomores who had between two and three years in their academies / programs responded that they strongly disagreed. It is interesting to note that these students estimated GPAs in the highest range. Disagreement and strong disagreement were spread across multiple adult subgroups.

There were 22 comments by participants for this survey item with eight positive, six negative, and the remaining remarks being neutral or unusable. Three words and phrases were each repeated three times across different comments. While the phrase "held accountable" was part of the item, the words "anyone" (frequency $=3,13.64 \%$ ) and "system" (frequency $=3,13.64 \%$ ) were repeated in both positive and negative contexts. One alumnus described an honor system within his TSA chapter in which "anyone [who] messed up was made aware but ... there wasn't any kid of real slacking," adding that students who could not meet their responsibilities were comfortable making their concerns known to chapter and the group "work[ed] together to help." In other responses, these words were used in descriptions of negative consequences for lack of performance, an organization's lack of debt payment to a regional, state, or national program, and involvement of the judicial system for civil and criminal offenses. One participant noted that theirs was a "volunteer organization and tools for holding anyone accountable [were] very limited" while another multi-venue program coordinator noted that they were
"happy when anyone is allowed to do their job" because without support, aerospace educators who were volunteers would "quit."

Item 12. Decisions about my academy / program are made by the people who have the best information available.

The most frequent response to this item was agree with a majority of approximately $52 \%$ of participants (Table C6 and Fig. D28). Slightly more than half of this proportion (29\%) responded strongly agree for a total of $80.3 \%$ of participants showing agreement with the item. Less than $8 \%$ of participants responded in disagreement ( $6.9 \%$ chose disagree and $0.9 \%$ chose strongly disagree). The remaining $12 \%$ of participants had no opinion. Orange (agree) was the predominant color band across most subgroups in the stacked bar graphs (Figs. D28 and D29). One of the small subgroups, other (undefined) role, showed a completely green (no opinion) bar. There appeared to be higher proportional disagreement (magenta - disagree and blue - strongly disagree) in the adult subgroups than in the student subgroups. There were no blue bands in the student subgroups, but they were spread across multiple adult subgroups.

Thirty-five participants added comments for this item. While the eight most frequently repeated words and phrases (repeated from five to seven times) were included in the item, there were an additional six words that were repeated at least three times (Fig. D29 and Table C7). The words "one, knows, level, and teachers" were each repeated across four different remarks, while "national, and students" were each repeated cross three different comments. Positive comments reflected decision-making by experienced stakeholders and subject matter experts.

These included remarks about instructional decisions such as "...the teachers had the experience and know how ... to teach and what to teach. They picked up on how the students learned best and made changes on the fly to accommodate to provide the best experience possible" and "decisions are made by the teachers and principals / higher faculty and staff [who] have the best interest of the academy's goal in mind and the information needed to understand and interpret that goal." Negative responses indicated a lack of information hindered decision-making, that personnel turnover "impedes th[e] informational pipeline," and that "higher ups having the final say" who were perceived to not keep individual academy's students interests and goals in mind making district-wide decisions. One adult stakeholder commented that decision-makers need to "do a better job of staying in contact with [the] industry."

Item 13. Important information about my academy / program is communicated to everyone in a timely manner.

Slightly more than half (50.3\%) of participants agreed with this statement, and another $24.3 \%$ responded strongly agree for a total of almost $75 \%$ responding positively to the item (Table C6 and Fig. D30). Just over $13 \%$ were in disagreement ( $12 \%$ disagree and $1.1 \%$ strongly disagree), which was almost the same as the proportion who had no opinion (12.3\%). The stacked bar graphs (Figs. D30 and D31) showed orange (agree) or a combination of orange and yellow (strongly agree) as the predominant color bands across all subgroups. There was some disagreement spread across multiple student and adult subgroups. It is interesting to note that the only blue (strongly disagree) bands appeared in White,
student, parent or guardian, and industry member / program mentor subgroups. The students were sophomores with one to three years in their academies / programs.

Twenty participants added comments related to this item, but three of the four common words were included in the item itself. The remaining word, "yes," was repeated in three of the 20 comments for this item (15\%). There were an equal number of seven positive and negative responses, while the remaining comments were neutral or unusable. Positive statements were general, indicating timeliness and methods by which information was disseminated (agendas, social media, opening announcements in classes). Negative comments included more specific details such as a lack of timeliness or, at the school level, missed opportunities for communicating course offerings, internships, or scholarships to advanced training. Three of the negative comments and two of the neutral comments presented a common sentiment that individual organizations were either in need of or constantly seeking ways to improve communication.

Item 14. When I have a question or concern about my academy / program, I can get answers or responses quickly.

The most frequent response to this item was agree with a slight majority of approximately $52 \%$ of participants (Table C6 and Fig. D32). Almost half of this proportion (approximately $25 \%$ ) responded strongly agree for a total of $77.7 \%$ providing positive responses. The proportion of participants who responded negatively comprised slightly more than $11 \%$ choosing disagree and just less than $1 \%$ choosing strongly disagree. The remaining $10 \%$ responded with no opinion. As with other items where the overall response agree was reflected in a
predominance of orange bands in the stacked bar graphs (Figs. D32 and D33), the same held for this survey item. There were yellow (strongly agree) bands in all subgroups except the other role category where all participants responded agree. Magenta (disagree) bands were spread across multiple subgroups, but blue (strongly disagree) bands were limited within demographics (male, White and Hispanic, core content teachers, industry members and program mentors, students). Within the student subgroups, only seniors responded that they strongly disagreed.

There were 24 comments accompanying responses to this survey item. Though eight words were repeated at least three times, four of these words were in the item stem (Fig. D33 and Table C7). The most common word that was not in the item itself was "teachers (or) professors" (20.83\%). Positive comments described instructional leaders who offered assistance outside of class, were perceived as being genuinely concerned about their students and focused on providing accurate and timely responses to questions or concerns from any stakeholders. There was one negative comment from a district-level stakeholder who suggested that "classroom teachers are notorious for not reading emails," indicating that upward responsiveness was less consistent than lateral or downward responsiveness. The words "support, take, and system" were each repeated in three different comments (12.5\%). Remarks including these terms were both positive and negative. One participant described a "great support system" while another described a developing support system in a newer program. Negative comments included the need for self-support or response communication "tak[ing] some time". Some participants indicated that information was usually or often communicated in a
timely manner, but one recognized that information from a district-level source might not be received as quickly because theirs was "just one of many programs in the district ... competing for attention and resources."

Item $15 R$. In my academy / program, there are specific groups of people (e.g., seniors who have been in the academy for four years, or math teachers) have better access to information we all need.

Half of the participants responded in agreement with this item; approximately $35 \%$ chose agree, and slightly more than $15 \%$ chose strongly agree (Table C6 and Fig. D34). Approximately 23\% disagreed, and another 3.4\% chose strongly disagree. Almost the same proportion chose no opinion (almost 24\%) as the entire group of those who responded in disagreement. Because this was a negatively written item, the proportion of participants who were in agreement, as well as the more varied level of responses (when compared to other survey items), indicated that item 15R might be problematic in hypothesis testing. The stacked bar graphs (Figs. D34 through D35) for this item reflected the variability in response choices across all subgroups. The strength of the negative responses (magenta - agree and blue - strongly agree) indicated a general consensus that the phenomenon described in the item warrants concern and the need for review in existing academies / programs. It is interesting to note that students with the lowest CTE GPAs (between a 2.00 and 3.00) showed no positive color bands (orange or yellow).

Though this item generated wider variability in response choices, there were only 25 additional comments. Six words were repeated three times in those
comments, but two of these words were included in the item itself (Table C7). The word "will" appeared in three positive statements about a school-based program converting from a club to an academic program, teachers who were willing to share information, and alumni mentoring of students who would be preparing for industry certification exams. Participants who discussed availability all indicated open access to materials and information, but one indicated that students and other stakeholders had to be motivated to use the materials or seek the information. Negative comments indicated that adult stakeholders had better access to information, and any stakeholders who had more experience were better able to seek the information they needed.

Item 16 . The way information is presented for my academy / program makes it difficult to understand.

A slight majority of participants (approximately 51\%) responded disagree to this item, and another $15 \%$ responded strongly disagree for a total of $66.5 \%$ choosing responses that would indicate a positive sense toward their academy / program (Table C6 and Fig. D36). The proportion of participants who chose agree or no opinion was almost equal ( $15.1 \%$ and $14.9 \%$, respectively), while $3.4 \%$ responded strongly agree. Orange (disagree) was the predominant color across many of the subgroups in the stacked bar graphs, indicating a generally positive response to participants' academies / programs with respect to this item (Figs. D36 and D37). However, there was greater variability in responses from students with most of the blue (strongly agree) bands appearing across their subgroups while only
in the CTE teachers subgroup for adults. Magenta (agree) and green (no opinion) bands seemed spread across almost all subgroups.

Thirteen participants commented on this survey item, but there were no words common to at least three of the responses. Seven remarks were positive with one negative, and the remaining five comments either neutral or unusable. Positive comments included brief expressions such as "it is easy to interpret" and "I get it all" to a very detailed description of the various ways one organization presents information via different social media and printed publications. One participant noted that the relatively small size of their organization made communication of information easier, but that information from outside the organization was sometimes more difficult to interpret. The negative comment seemed to describe individuals in a school guidance or scheduling setting, "Because it is so hard for non-aerospace people to understand aerospace, they have a hard time explaining what the program truly does."

Item 17. We use teamwork to get work done in my academy / program.
The most frequent response to this item was strongly agree with approximately 47\% of participants (Table C6 and Fig. D38). Almost the same proportion responded agree (approximately 44\%) for a total of $89.3 \%$ of participants showing agreement with the item. There was some disagreement with almost $5 \%$ of participants choosing disagree and another $0.3 \%$ choosing strongly disagree. The proportion of participants who disagreed with the statement was almost the same as the proportion who had no opinion (4.9\% and 4.6\%, respectively). The stacked bar graphs reflected generally positive attitudes toward
the academies / programs with respect to this item (Figs. D38 and D39). Orange (agree) and yellow (strongly agree) bands were the largest. It is interesting to note that the only blue (strongly disagree) color bands were for a White female parent / guardian. Magenta (disagree) bands were spread across multiple subgroups as were green (no opinion) bands.

There were 16 comments for this item with three words showing repletion in at least three remarks. However, all three of these words were part of the item itself. Seven comments were positive, with three negative and the remainder neutral or unusable. Positive responses included "teamwork is critical in Civil Air Patrol" and "teamwork gets the job done a lot quicker than working alone." One adult stakeholder described "incorporate[ing] parent assistance, teacher colleagues, organizations, local airport management and fixed-base operations" to enhance their program offerings for students. Negative comments reflected programs that present an appearance of employing teamwork but relying more heavily on one or two individuals and that teamwork was not consistent across all classes in an academy.

Item 18. People who have different skills, knowledge, or talents, work together to make the best decisions for my academy / program.

Agree was the most common response selected by approximately $47 \%$ of participants (Table C6 and Fig. D40). Almost the same proportion responded strongly agree (approximately 43\%) for a total of $89.2 \%$ of participants showing agreement with the item. There was less than $5 \%$ negative response to the item ( $4.6 \%$ disagree and $0.3 \%$ strongly disagree). A greater proportion of participants
(6\%) had no opinion. The stacked bar graphs (Figs. D40 and D41) exhibited large orange (agree) and yellow (strongly agree) bands across most subgroups. Green (no opinion) bands occurred across several subgroups. Magenta (disagree) bands were evident across multiple adult subgroups, but only appeared as responses for juniors who had between three and four years in their academies / programs and estimated GPAs less than a 4.00 . The only participant who responded strongly disagree was a female Hispanic CTE teacher / program instructor.

There were 32 comments for this item, with ten words or phrases that were repeated in at least three different responses (Fig. D41 and Table C7). Among these words and phrases, five were included in the item itself. The most common words not included in the item were "see, help, and everyone" (12.50\% each). Remarks including the words "see" and "everyone" were all positive, describing the beneficial impact of multiple perspectives, collaboration, and seeking the best alternatives for meeting program goals and objectives. Similarly, the word "help" was part of all positive responses, with descriptions of establishment of a non-profit to generate funding and serve as an advisory board, use of multiple perspectives to develop more comprehensive plans, and collaborative efforts to expand student understanding and facilitate their success. Two of three comments including the word "little" were negative, describing participation and involvement levels and administrative requirements that the stakeholder believed had "little to no bearing on ... daily activities." In general, positive comments reflected an appreciation for diverse input while negative comments reflected concerns related to larger
organizations with more bureaucracy or that the individual participant felt like their input was not appreciated.

Item 19. Everyone involved with my academy / program (students and / or adults) is able to have input about what we do and the direction we are going.

The most frequent response to this item was agree with a majority (approximately 54\%) of participants (Table C6 and Fig. D42). Another 21\% chose the response strongly agree for a total of $75.4 \%$ of responses indicated a positive reaction to the item. Approximately $13 \%$ of participants disagreed with the item, and slightly more than $1 \%$ chose strongly disagree, for a total negative response proportion of just over $14 \%$. The remaining $10.3 \%$ responded with no opinion. The stacked bar graphs showed orange (agree) bands as the largest across almost all subgroups, with the exception of adults in the lowest household income bracket where the majority of participants responded strongly agree with a smaller percentage of green (no opinion) and magenta (disagree) responses (Figs. D42 and D43). Green and magenta color bands were evident across multiple subgroups, but blue (strongly disagree) bands occurred only in the student subgroup of seniors with at least four years in their academies / programs who had the lowest (between 2.00 and 3.00) estimated GPAs, and among adult administrators and advisory board members / program mentors.

Four of the 21 comments for this item included the word yes for a $19.05 \%$ usage rate. Three of these remarks included explanatory comments that collaborative input was effective at the local level, but the direction of the organization was subject to external parameters set at higher levels. The other two
common words were in the item stem. There were more positive comments than negative (ten vs. seven) with four neutral comments. The underlying theme across these comments was that external parameters influenced local organizations' direction. There were also negative comments reflecting concerns that students who did not exhibit an interest in aviation / aerospace / engineering were placed in academies against recommendations by counselors and teachers and given the opportunity to express their opinions about the direction of those academies, even though they did not intend to pursue careers in these fields. Item 20R. In my academy / program we have power struggles that affect how well we achieve our goals and objectives.

Disagree was the most frequent response to this item with approximately $35 \%$ of participants (Table C6 and Fig. D44). Almost 10\% of participants chose strongly disagree for a total of $44.3 \%$ expressing a positive sentiment regarding their academy / program. The proportions of participants who chose agree or no opinion were almost equal (just over $23 \%$ and $22 \%$, respectively), while just under $11 \%$ chose strongly agree. The greater variability in responses to this item may reflect an issue with the item in hypothesis testing. The stacked bar graphs (Figs. D44 and D45) exhibited wider variation in responses, similarly to the overall responses shown in Figure D44. The greatest variation (with the least positive strongly agree or agree) was within the student subgroups, and the greatest degree of non-positive responses (blue - strongly agree and green - no opinion only) came from students with the lowest CTE GPAs (between 2.00 and 3.00). The largest orange (disagree) bands were across the adult subgroups. It is important to note
that, though the American Indian or Alaskan Native subgroup was very small, there were only negative (magenta - agree or blue - strongly agree) responses provided by this subgroup.

There were 27 comments for this item, including nine negative, seven positive, and 11 neutral remarks. Ten words were repeated at least three times, but two of these words were in the item itself (Fig. D45 and Table C7). The most commonly repeated word was "sometimes" $(18.52 \%)$, which supports the fact that the largest proportion of comments were neutral. Participants wrote that the local level did not have power struggles, but they were apparent at a higher organizational level, and that "sometimes the struggles are behind the scenes and not everyone in the program is privy to [those] struggles." Positive comments described having a small cadre in leadership roles as well as one participant who found a silver lining, "differing opinions are what drive an organization." Negative comments described specific programs within an academy (i.e., physical training, drill) appearing to take precedence or disputes that were difficult to solve that may have led to academy teachers having a higher attrition rate.

Item 21. We have the supplies and material resources we need to meet the goals and objectives of my academy / program.

The most frequent response to this item was agree with approximately $49 \%$ of participants (Table C6 and Fig. D46). Another 27\% responded strongly agree for a total of $76.2 \%$ of participants showing agreement with the item. Approximately $14 \%$ of participants disagreed with the item, and an additional $1 \%$ responded strongly disagree. The remaining $8.3 \%$ chose no opinion as their
response. The most prevalent color band across all subgroups (Figs. D46 and D47) was orange (agree). In the few cases where it was not the widest band for a subgroup, that bar had a wider yellow (strongly agree) band except for the students with one to two years in their program. This subgroup showed the greatest proportion of disagreement (magenta - disagree and blue - strongly disagree) for all student groups. Though magenta bands were spread across multiple subgroups, only students and CTE teachers / program instructors strongly disagreed with this item. It is interesting to note that the students who strongly disagreed were among those with the highest estimated GPAs.

There were 45 comments for this item. Of the nine common words, only five were not included in the item (Fig. D47 and Table C7). Within this group, "school, better, and funding" were the most common ( $11.11 \%$ each). Both positive and negative comments reflected funding concerns. One academy described the establishment of a non-profit to raise funds for equipment and supplies that neither the district nor the university partner could underwrite. Other participants discussed local sponsors and donors who assisted with development to facilitate successful conferences, national levels of their organizations that disseminated materials and equipment whenever requested, and the "tremendous" support of volunteers. There was a broad spectrum of negative comments, describing outdated texts, limited software and hardware for technology-driven curricula, with more than one participant using the term "underfunded," including one stakeholder who categorized their program as "woefully underfunded." One participant explained further, "Initial grants are great for initiating, but there are often no provisions made
for sustainment. My program is having a hard time buying program-specific consumables." Another stakeholder lamented the approval process and lack of true understanding of related equipment, "Our school Risk Management Team is ... afraid of flying. We were donated a simple fuselage and it was rejected by Risk Management."

Item 22. We have the technology and equipment resources we need to meet the goals and objectives of my academy / program.

Agree was the most frequent response to this item with a majority of $52 \%$ of participants (Table C6 and Fig. D48). Another 24\% responded strongly agree for a total of $75.4 \%$ of participants showing agreement with the item. Almost $15 \%$ of participants disagreed with the item, and another $2 \%$ chose strongly disagree. The remaining $8 \%$ of participants indicated no opinion. Orange (agree) and yellow (strongly agree) were the most prevalent bands across subgroups in the stacked bar graphs (Figs. D48 through D49), reflecting overall agreement with this item across demographic groups. Green (no opinion) and magenta (disagree) bands, though generally smaller, were also spread across multiple subgroups. No students strongly disagreed with the item, but it is interesting that among adults, there were blue (strongly disagree) bands in the administrator, CTE teacher / program instructor, and parent / guardian subgroups. In general, these are the subgroups that have the most contact with students or are responsible for acquiring equipment and technology for programs.

Forty participants added comments for this item. Six of 13 words that were repeated in at least three responses were included in the item itself (Fig. D49
and Table C7). Of the remaining seven common words, "use" and "available" appeared in comments describing potential for growth or staying current with updated equipment, adding the caveat that academies / programs were "mak[ing] do" with what they had because funding for such equipment was limited. Limited funding was a recurring reason in most of the negative comments for this item, as was description of the need to update older equipment to stay current with aviation / aerospace / engineering industry expectations. One participant involved with TSA described a new web-based event management system incorporating leased iPads that could be loaded with software developed by program alumni, explaining that this system reduced costs for storage, transportation, updating, and maintenance of equipment that was only needed for competition events. Even in comments where the participant believed their academy / program had enough technology and equipment, most also suggested that more equipment or more advanced technology would help in attracting a larger number of students and enhance their career education experiences.

Item 23. We have the people (students and / or adults) we need to meet the goals and objectives of my academy / program.

The most common response to this item was agree with a majority of $53 \%$ of participants (Table C6 and Fig. D50). The next most frequent response was strongly agree (approximately 19\%) for a total of $71.5 \%$ of participants showing agreement with the item. Approximately 18\% of participants responded disagree, and another $2 \%$ chose strongly disagree. Just under $9 \%$ responded with no opinion. In examining the stacked bar graphs (Figs. D50 through D51), orange (agree) bands
were the most prevalent across almost all subgroups. The exceptions included small racial subgroups (American Indian or Alaskan Native and Hispanic) where there was a wider variation in color bands that was also a reflection of the small sizes of these groups, and sophomore students and adults in the lowest household income bracket where yellow (strongly agree) bands were wider. Green (no opinion) and magenta (disagree) bands were spread across most subgroups. As with item 24, the subgroups that included blue (strongly disagree) bands were administrators, CTE teachers and program instructors, and parents / guardians, with the addition of students. Students who strongly disagreed with this item were upperclassmen with at least three years in their programs and estimated GPAs of at least a 3.00. This phenomenon may be of interest because student leaders in academies and community-based programs tend to be from these subgroups (and they would likely have the most interaction with adult leaders responsible for personnel issues).

There were 32 comments for this item. Three of the repeated words were in the item itself (Fig. D51 and Table C7). For this analysis, the word "always" and the phrase "always use" were combined. Seven of these comments expressed the sentiment that an academy / program could "always use" more personnel, while one indicated that a community-based program's volunteer advisors were "always stressed for time." Positive comments reflected diversity within an organization and strong collaboration toward achieving organizational goals. Negative comments described limiting factors such as organizational regulations, vacancies
in volunteer programs and schools, and the challenge of "effectively putting raw talent to good use."

Item $24 R$. Resources are not always used for activities that align with the academy/ program vision.

The most frequent response to this item was disagree with $36 \%$ of participants (Table C6 and Fig. D52). An additional 10\% responded strongly disagree for a total of $46 \%$ of participants showing a positive opinion about their academy / program (as the item is written in the negative form). Approximately $26 \%$ of participants agreed with the item statement, and almost $5 \%$ responded strongly agree. The remaining $26 \%$ of participants chose no opinion. These proportions, as pictured in the bar graph (Fig. D52) indicate greater variability in responses from participants for this item than in most other items. The wider variability shown in Figure D52 was echoed in the stacked bar graphs (Figs. D52 and D53). Generally positive responses (orange - disagree and yellow - strongly disagree) were more prevalent among adult stakeholders than students. The only exception to this phenomenon was the adult subgroup for other where the bar was entirely green (no opinion). Students strongly agreed with this item across all grade levels, but those with estimated GPAs less than 3.00 did not have a blue band. The only adult subgroups that did not have a blue band were the aforementioned other, advisory board members, and alumni. The wider appearance of blue and magenta (agree) bands for this item indicate a concern for decisions being made about the academies / programs. It may also indicate an issue with this item for the
hypothesis testing phase, as response rates were not consistent with those seen in other items.

There were 17 comments for this item with two repeated words, but both of these words were included in the item itself. It is interesting to note that the majority (59\%) of comments were negative, which was not evidenced in comments for other survey items. These remarks reflected limited or lacking resources, a concern that there was "no true vision," and instances when resources had been used for "unintended purposes." Neutral responses appeared to be explanations why participants had chosen no opinion, citing a lack of knowledge or qualification to respond to the item with a directional opinion. The positive responses reflected organizational focus on aviation and a participant's belief that their academy / program did not have extensive resource requirements so what was present was adequate to achieve goals and objectives associated with the vision statement. Item $25 R$. It is difficult to determine who makes decisions about how to use resources for my academy / program.

The most frequent response to this item was disagree with approximately $50 \%$ of participants (Table C6 and Fig. D54). An additional 13\% of participants responded strongly disagree for a total of $63.4 \%$ showing a positive sentiment related to their academy / program. Just over 19\% responded agree, and just under $3 \%$ chose strongly agree. The remaining $14.6 \%$ responded with no opinion. Orange (disagree) was the most prevalent band in the stacked bar graphs (Figs. D54 and D55) across adult subgroups. This was not the case for student subgroups. Upperclassmen and students with GPAs less than a 4.00 showed a wider variation
in responses with larger proportions of agreement with the item. Students, CTE teachers / program instructors, and industry members / program mentors were the only subgroups where blue (strongly agree) bands appeared. Even though the American Indian or Alaskan Native subgroup was very small, it is interesting to note that these participants only chose no opinion or strongly agree for this item.

Though there were 11 participants who commented on this survey item, there were no words common to at least three of the comments. Five participants responded in a positive manner and described supportive immediate supervisors and very visible or easily identified decision-makers. Three negative comments suggested that there was a very small group of decisions makers or discussed the outcome of limited resources for students, "If we have any paper and pencils, I am directly responsible for which children might have the benefit of the paper and pencils. We seldom have more elaborate materials."

Item 26. My academy / program provides opportunities for me to improve my related skills, knowledge, or talents, if I want to participate.

Agree was the most common response to this item with a majority of $53 \%$ of participants (Table C6 and Fig. D56). Approximately 39\% responded strongly agree for a total of $91.7 \%$ showing agreement with the item. Less than $3 \%$ of participants showed disagreement with the item ( $2.6 \%$ disagree and $0.3 \%$ strongly disagree). The remaining $5.4 \%$ responded no opinion. Examining the stacked bar graphs (Figs. 56 and D57) reflected the substantial overall positive response to this item. Orange (agree) and yellow (strongly agree) bands were the most prevalent across all subgroups. Though there were green (no opinion) bands for most adult
and student subgroups, the only magenta (disagree) bands appeared in the junior and senior students with at least three years in their programs and estimated GPAs between 3.00 and 4.00 and in the adult bars for CTE teachers / program instructors, core content teachers, and industry members / program mentors. The only adult responding strongly disagree was an administrator.

There were 18 comments for this item. Three of the five most common words were in the item stem, but three responses (16.67\%) each included the words "yes and learn." Most of the responses described positive attributes of academies / programs, such as academic tutoring for struggling students and extracurricular activities to augment career education learning. One industry member argued that "students drive their own success far more than the [program] administrators ever do." Another adult stakeholder also supported this idea that motivated students would seek available opportunities and resources. One adult stakeholder explained that their program did not offer opportunities for the adults, but those prospects "arise through [the participant's] own endeavors." Negative comments described programs that did not involve industry partners in facilitating learning opportunities for school personnel who were in supporting roles for academies, while another participant lamented the availability of "educator-based learning" but not industryrelated skills training for adult stakeholders.

Item 27. Everyone (students and / or adults) in my academy / program is involved in lifelong learning to increase their related skills, knowledge, or talents.

The most frequent response to this item was agree with approximately $50 \%$ of participants (Table C6 and Fig. D58). Approximately 27\% responded strongly
agree for a total of $76.9 \%$ of participants indicating agreement with the item. Approximately $10 \%$ chose disagree, and slightly more than $1 \%$ chose strongly disagree. The remaining $11.7 \%$ had no opinion. Orange (agree) was the most prevalent color band across almost all subgroups in the stacked bar graphs (Figs. 58 and D59). The exceptions were American Indian or Native American where a wider variation appeared, but this phenomenon was likely more dependent on the small number in this subgroup, students with a CTE GPA less than 3.00 where green (no opinion) was the predominant color band, and adults in the lowest household income bracket where yellow (strongly agree) was the predominant color band. Green color bands appeared in most subgroups, and magenta (disagree) color bands were spread across multiple subgroups. Blue (strongly disagree) bands only appeared in the bars representing administrators, alumni, parents / guardians, and students - specifically seniors with at least four years in their academies / programs.

There were 22 comments for this item but only three repeated words, two of which were in the item itself. The word "members" was repeated in three items (13.64\%). All three of these comments were negative, reflecting large numbers of organization members but few who actively participated over the long term. One academy alumnus explained that most of his peers were "bound and determined [to attend] college or ... trade school so that they could continue to spend time in a similar field." An adult stakeholder related that they had been studying aviation for 60 years, earning multiple flight ratings. Negative comments centered on a lack of universality of lifelong learning, suggesting that individuals who pursued learning
opportunities in aviation / aerospace / engineering did so because they were motivated to learn more so than because the program encouraged such activities. Item $28 R$. My academy / program does not provide a support system for helping participants meet their responsibilities.

Disagree was the most frequent response to this item with a majority of $52 \%$ of participants (Table C6 and Fig. D60). The next most common response was no opinion with $16.6 \%$ of participants. Strongly disagree was the response for $15.7 \%$ of participants, indicating that $67.4 \%$ showed a positive opinion about their academies / programs. Those in agreement with the item accounted for $12.6 \%$ with an additional $3.4 \%$ responding strongly agree. Orange (disagree) color bands appeared in all subgroup bars in the stacked bar graphs (Figs. D60 and D61) except American Indian or Alaskan Native where the small size of the subgroup may have been the cause of the disparity. Within racial subgroups, American Indian or Alaskan Native and Asian / Pacific Islander (both small subgroups compared to the other race categories) showed higher proportions of responses indicating a negative (magenta - agree and blue - strongly agree) feeling with regard to their academies / programs relative to this item. Though green (no opinion) color bands appeared across most subgroups, they represented larger proportions in student subgroups than adult subgroups. Blue and magenta color bands were spread across most subgroups as were yellow (strongly disagree). It is interesting to note that among students with the highest estimated GPAs, the proportion of participants who strongly agreed with this item was almost equal to the proportion who strongly disagreed with it.

There were no words from participant comments that were common to at least three responses and not included in the item itself. Half of the comments were positive, with three negative remarks and the remaining comments either neutral or unusable. Positive responses ranged from statements that support systems existed to more detailed explanations of what types of support programs were available (i.e., tutoring program for struggling students). One participant stated that their program had both peer and instructional levels of support. Negative comments indicated that systems were not in place or not in place yet.

Item 29R. I believe I can learn more career-related knowledge associated with my academy / program outside the academy / program than by participating withinit.

The most frequent response to this item was disagree with approximately $44 \%$ of participants (Table C6 and Fig. D62). An additional 11.7\% responded strongly disagree, indicating that a majority of $55.7 \%$ chose responses reflecting a positive opinion about their academy / program. Approximately 19\% of participants disagreed with the statement, and more than $13 \%$ chose strongly disagree. The remaining $12 \%$ had no opinion. There is a wider variation in answer choices other than the most frequent disagree. Examining the stacked bar graphs (Figs. D62 and D63) showed predominantly positive feelings (orange - disagree and yellow - strongly disagree) about academies / programs across all adult subgroups. However, there was a wider variation in the student responses with the greatest proportion of blue (strongly agree) and magenta (agree) reflecting overall negative feelings about academies / programs with respect to this item. Blue and magenta bands appeared across almost all adult subgroups with exceptions for
advisory board members and those with household incomes in the highest bracket (magenta only) and other level of participation and those in the second highest household income bracket (orange) only.

This item had 22 participant comments with six common words. Of those six words, only two were not in the item itself: "aviation" (frequency $=3,13.64 \%$ ) and "wanted" (frequency $=3,13.64 \%$ ). Two remarks including the word "aviation" were positive, indicating that stakeholders pursued multiple avenues to add to the knowledge base for their academies / programs. The negative comment including the word "aviation" described a training program for "teachers with no aviation background" and suggested that student enthusiasm was not facilitated by existing learning opportunities for the adults with whom they would interact. The word "wanted" appeared in statements that suggested student and adult personal motivation to learn was a greater factor in continuous improvement than specific program offerings. One alumnus believed that if he had wanted to learn anything about the subject matter while enrolled in his academy, he needed only to ask one of the instructors. A student described learning from peers as well as adult stakeholders, and an industry member commented that "improving the academy involves work inside and outside the program."

Item 30. My academy / program is flexible enough to adapt to change in related industries or academic requirements.

The most frequent response to this item was agree with a majority of $53 \%$ of participants (Table C6 and Fig. D64). Additionally, more than $27 \%$ responded strongly agree for a total of $80.5 \%$ showing agreement with the item.

Approximately 7\% of participants responded disagree, and slightly more than $1 \%$ chose strongly disagree. The remaining $11.1 \%$ of participants had no opinion. Orange (agree) and yellow (strongly agree) color bands appeared consistently across almost all subgroups in the stacked bar graphs (Figs. D64 through D65), reflecting substantially positive feelings about academies / programs with respect to this item. The only exceptions were in adult subgroups for other level of participation and in the second highest household income bracket where the entire bars were green (no opinion). Magenta (disagree) color bands appeared across multiple subgroups for both students and adults. The only blue (strongly disagree) bands in student subgroups described seniors with at least four years in their programs and estimated GPAs less than 3.00. Within adult subgroups, blue bands only appeared in advisory board member / program mentor, parent or guardian, and CTE teacher / program instructor bars. However, in examining the adult hours to the program graph, this description could eliminate CTE teachers, indicating the instructors who strongly disagreed with this item were likely volunteers or involved with community-based programs rather than school-based academies.

This item had 18 comments, but all three common words were in the item itself. Ten of the comments were positive, including a discussion of a program being completely revamped to "focus on the skills needed in the aerospace industry" and another "continually adapt[ing] to changing community needs, technology, and industry input." Negative comments reflected concerns about education system requirements and parameters hindering flexibility. Other issues that were raised in some items were limited funding to support equipment and
technology changes in industry and human nature to resist change. One participant indicated that change in their academy / program was dependent on instructor certifications.

Item 31. I believe myacademy / program gets better (with respect to the vision statement, goals, and objectives) every year.

Agree was the most frequent response to this item with more than $48 \%$ of participants (Table C6 and Fig. D66). Additionally, approximately 33\% responded strongly agree for a total of $81.2 \%$ of participants showing agreement with the item. Only $4 \%$ of participants responded disagree, and less than $1 \%$ chose strongly disagree. The remaining $14.3 \%$ of participants had no opinion. Orange (agree) was the predominant color band in the stacked bar graphs (Figs. D66 and D67) for this item across almost all subgroups. In student subgroups (freshmen and sophomores, students with fewer than two years in their programs, and adults devoting at least ten hours per week to their academies / programs), yellow (strongly agree) color bands reflected either larger or the same proportion of the bar. Across all subgroups, orange and yellow color bands covered the majority of each bar in the graph. Green (no opinion) and magenta (disagree) color bands were spread across most subgroups, but one White male administrator and one White male CTE teacher also showed strong disagreement with the item.

This item had 36 additional comments by survey participants. Of the 20 words repeated in at least three remarks, five were included in the item itself (Fig. D67 and Table C7). The word "learning" was more common in positive comments such as "I believe my program is a quality program every year providing students
with unique opportunities to learn" and "I have only been her one year but so far the academy has largely changed, with new equipment and new ways of learning." One participant discussed continuous improvement as a component of success, "we take lessons learned from each successive year and apply them to the upcoming year." A negative comment described the need to learn how to adjust for lack of support and funding. Limited funding appeared in other negative comments for this item, indicating that it was a concern common to both school-based academies and community-based programs. Neutral comments reflected variance in levels of improvement from year to year, citing lack of consistency, changes in priorities, or personnel turnover as reasons. Positive comments reflected systemic procedures for updating literature and materials, personal involvement by instructional faculty, and collaborative practices involving multiple stakeholders in academy review. Item 32. I believe everyone involved with my academy / program (students and / or adults) plays a part in making myacademy / program better (with respect to the vision statement, goals, and objectives).

A majority (57\%) of participants responded agree to this item (Table C6 and Fig. D68). The second most frequent response was strongly agree (approximately $28 \%$ ) for a total of $85.4 \%$ of participants showing agreement with the item. Approximately $6 \%$ of participants disagreed with the item, and just under $1 \%$ chose strongly disagree. The remaining $7.4 \%$ had no opinion. In the stacked bar graphs (Figs. D68 and D69), the predominant color band was orange (agree), except students with estimated GPAs less than 3.00 and adults in the lowest household income bracket where the yellow (strongly agree) color bands were
larger, and American Indian and Alaskan Native where the small size of the subgroup and variance of answers from strongly agree to no opinion generated an even distribution across the three color bands. Green (no opinion) and magenta (disagree) color bands were spread across multiple subgroups. The only blue (strongly disagree) color bands were exhibited in the male administrator and student groups (freshmen and seniors).

This item had 15 additional comments from survey participants. Of the five words that were repeated in three comments each (20\%), two were included in the item itself. The word "true" was a single-word positive response and as part of two responses that included both positive and negative components. One remark separated local organization members whom the participant believed were working to make the academy / program better from "outside powers that be" whom they did not believe were as dedicated to continuous improvement. The other somewhat neutral response involved a statement about the possibility of "forcing involvement" but that with a volunteer organization that was not appropriate nor conducive to long-term organizational success. Another negative comment suggested that a community-based organization in which aerospace education was only one of several activities did not place as much emphasis on continuous improvement in its educational program as it did on other programs. There were an equal number of positive and negative statements, with neutral statements indicating that some stakeholders were interested in continuous improvement, but that the efforts were not universal.

Item 33. I believe my academy / program is a successful organization (with respect to the vision statement, goals, and objectives).

The most frequent response to this item was agree with approximately $50 \%$ of participants (Table C6 and Fig. D70). Approximately 41\% responded strongly agree for a total of $91.4 \%$ showing agreement with the item. Approximately $2 \%$ of participants disagreed with the item, and less than $1 \%$ chose strongly disagree. The remaining $5.7 \%$ had no opinion. Orange (agree) and yellow (strongly agree) color bands were predominant across all subgroups in the stacked bar graphs (Figs. D70 and D71) except the small subgroup of American Indian and Alaskan Native where green (no opinion) was the predominant color band. Green bands also appeared across a number of other subgroups, but magenta (disagree) and blue (strongly disagree) were much more concentrated. Only Black or African American and White subgroups exhibited this color band, and within the role demographic, it only appeared for advisory board members, CTE teachers / program instructors, and students. Within the student subgroup, only juniors with three to four years in their programs having estimated GPAs under a 3.00 exhibited such strong negativity.

Although there were 18 participants who provided comments with their responses to this survey item, there were no words or phrases common to at least three comments made that were not included in the item itself. The majority of these comments (61.11\%) were positive, citing accomplishments such as "help[ing] youth become righteous citizens," increasing membership in a volunteer organization, or "turn[ing] heads within the student [body] at the school". One participant suggested that if their academy / program could be replicated, "that
would be its greatest strength." The only negative comments suggested that stakeholders in the participant's academy / program did not use existing "tools" to facilitate success, and that aerospace education required dedicated time within a multi-purpose organization in order to facilitate the program's success. Neutral statements focused on the newness of participants' academies / programs and continuous improvement efforts.

Item 34. My academy / program is recognized as successful by others through awards, public media (newspaper, online, or television reports of achievement), or other methods.

The most frequent response to this item was agree with approximately $45 \%$ of participants (Table C6 and Fig. D72). The next most common response was strongly agree (approximately $33 \%$ ) for a total of $77.5 \%$ of participants reflecting positive opinions about their academies / programs. Approximately 6\% disagreed with the statement, and $2 \%$ chose strongly disagree. The remaining $14 \%$ of participants had no opinion. The predominant color bands in the stacked bar graphs (Figs. D72 and D73) were orange (agree) and yellow (strongly agree), reflecting general positive feelings across most subgroups with respect to their academies / programs. Within the race demographic, the widest variety of responses with the most variability was submitted by Black or African American participants. Green (no opinion) color bands occurred in most subgroups, and magenta (disagree) color bands were spread across multiple subgroups as well. The least common response (blue - strongly disagree) was limited to sophomores with estimated high school GPAs less than 3.00 in the student subgroup, and
administrators, alumni, parents / guardians, and CTE teachers / program instructors among adults.

There were 38 comments for this item. Among 20 words and phrases repeated at least three times, five were included in the item itself (Fig. D73 and Table C7). The most common word was "students," used in positive comments in which the participants explained how individual students were recognized and motivated to succeed. Adult stakeholders described specific media they used to publicize their students' and their academies' / programs' achievements (the most commonly cited are included in Fig. D73). One participant explained that they made sure student accolades were publicized locally at least twice per quarter, while others discussed facilitating widely publicized ceremonies to announce student and academy / program accolades each year. It was interesting to note that some participants believed more strongly in intrinsic reward than publicized accolades with comments such as, "to the student involved [reward is] a measure of self-worth and knowledge" and "awards don't make the program. People and experiences do, then how prepared I am for the job market." The few (18\%) negative comments ranged from statements that no outside recognition had ever occurred to "we need to do a better job in this area."

Item 35. I would recommend my academy / program to students / colleagues who I know who are interested in aviation / aerospace / engineering education and / or careers.

Strongly agree was the most common response to this item with a majority of $57 \%$ of participants (Table C6 and Fig. D74). Approximately $35 \%$ responded agree for a total of $92.3 \%$ positive response to the item. Approximately $2 \%$ of participants disagreed
with the item, and less than $1 \%$ chose strongly disagree. The remaining $4.9 \%$ had no opinion. The yellow (strongly agree) and orange (agree) color bands were predominant across almost all subgroups in the stacked bar graphs (Figures D74 though D75), with the exception of an even distribution from yellow to green (no opinion) for the American Indian or Alaskan Native subgroup (a biproduct of the small number of participants in this subgroup). Green (no opinion) color bands were spread across most subgroups, but disagreement (magenta - disagree and blue - strongly disagree) was concentrated among CTE teachers / program instructors, industry members / program mentors, parents or guardians, and students. Only juniors and seniors with estimated GPAs under 4.00 expressed any disagreement.

There were no repeated words common to at least three participant comments that were not in the survey item itself. The majority of responses ( $60 \%$ ) were positive, including descriptions of programs in which the participant had mentored other adult stakeholders who now lead similar programs elsewhere and an academy's / program's "commit[ment] to education as a core value $\ldots$ and aviation is [its] specialty." One participant responded that "aerospace is the leading industry in [their] state, TSA has aviation and aerospace, engineering, design and technology related competition events" indicating that though the organization had a variety of career education components, it embraced each of those components to achieve success. There were only two negative comments, and in both cases the participant indicated that their reticence to recommend their academy / program was related to personalities of specific individuals or limitations in resources and outdated equipment.

## Reliability and Validity Testing Results

Internal consistency reliability for the survey instrument was performed in the same manner as the initial pilot study, with calculation of Cronbach's alpha. The responses from 350 participants who completed all 35 survey items were used for this statistical testing, with a resulting Cronbach's alpha of 0.917 . This value was slightly lower than the calculated result in the pilot study ( 0.955 ), but well within the range considered excellent (>0.70). As was the case with the pilot study reliability testing, one must consider Tavakol's and Dennick's (2011) caution that a high value for alpha may be the product of a longer instrument rather than a high degree of internal consistency. In the case of the pilot study analysis, individual values were calculated for the constructs or factors included in this project. It was not necessary to perform this additional analysis, because this study involved EFA to identify constructs derived from the collected data and CFA to examine reliability and validity of the measurement model.

## Exploratory Factor Analysis

Validation of assumptions was based on Hair et al. (2010) discussion. They indicated that EFA should only be performed if an intercorrelation matrix includes a substantial number of correlations greater than 0.30 . The inter-item correlation matrix for this study showed 238 of 496 , or almost $48 \%$, inter-item correlations greater than 0.30 (Table C8). Although this was not a majority, it may be considered acceptable in combination with validation of other assumptions. An important anomaly that appeared in Table C8 was that survey item $15(\mathrm{Q} 15 \mathrm{R})$ had only one inter-item correlation (with Q24R) greater than 0.30 . This observation indicated the possibility that item 15 should be removed from analysis, which would result in 237 of 465 , or $51 \%$, inter-item
correlations greater than 0.30 . Hair et al. stated that a Bartlett's test of sphericity with $p$ value $<0.05$ would indicate that "sufficient correlations exist among variables to proceed" (p. 105). The results of a Bartlett's test associated with the correlation matrix shown in Table C8 were significant (approximate $X^{2}=4627.253$ with $496 d f$ and $p$-value $<0.001$ ). Another statistical test to measure intercorrelation is the Kaiser-Meyer-Olkin measure of sampling adequacy (MSA) for which a value of 0.80 or above is considered commendable. The MSA statistic associated with the correlation matrix shown in Table C8 was 0.917 . It should be noted that MSA values increase when the sample size increases and when the number of variables increases. Hair et al. asserted that, in addition to examining the MSA value for the entire model, it should be investigated as well as for individual manifest variables. MSA values for all manifest variables are provided by SAS on the diagonal of the anti-image correlation matrix. All manifest variables had MSA values greater than 0.827 (Table C9). Hair et al. also argue that the remaining partial correlations in the anti-image correlation matrix should all have absolute values less than 0.7 (Table C9). While most of the partial correlations have absolute values less than 0.200 , the greatest absolute value is 0.522 , meeting this criterion.

In validating that an underlying factor structure exists, the researcher considered that all of the survey participants self-identified as stakeholders in aviation / aerospace / engineering programs, and the focus of the study was to determine the components and their relationships within the organizational design of a successful program; it appeared the second conceptual issue could be confirmed as well. In addition to validating conditions for using EFA, it was necessary to review sample size guidelines. Given EFA
sample size guidelines (a minimum of 10 cases per survey item), the study sample size of 350 would be considered a minimum for the number of variables included.

Another concern associated with EFA is multicollinearity. Although Hair et al. recognized that "some degree of multicollinearity is desirable," Field (2009) argued that the item correlation matrix should result in a determinant $>0.00001$. The determinant for the item correlation matrix including all manifest variables except items 33 through 35 was $1.1111 \times 10^{-6}$, indicating the need to reduce the matrix through elimination of some of the survey items from further analysis. However, such elimination must be tempered by a concern for losing potentially important information. Given concerns about Q15R from its descriptive statistics analysis and that it did not correlate to any item other than Q24R, it was removed from the data set, and the determinant for the new correlation matrix was calculated. This statistic increased to $1.392 \times 10^{-6}$, which was not above the 0.00001 threshold $\left(\mathrm{KMO}=0.918\right.$, Bartlett test of sphericity $X^{2}=4555.535$ with $d f=465$ and $p=$ value $<0.001$ ). No other survey items stood out in the correlation matrix as problematic at this point. SPSS Basic can be programmed to produce the inter-item correlation matrix and related determinant in each run of EFA. Because the EFA process offers results related to the value of a variable to a factor model (and by extension variables not related strongly to factors can be eliminated from further analysis), investigation of survey items that could be removed from analysis was continued as part of the EFA procedure.

Exploratory factor analysis for this study included survey items except for item 15 R (removed based on inspection of the correlation matrix) and items 33 through 35 , as these items were designed to represent the underlying factor of success. Default
parameters (eigenvalues $>1.00$, maximum iterations for convergence $=25$ ) were used for the initial EFA. Communalities, the relationship between a single variable and all other variables before any matrix rotation, for the 31 survey items included in the analysis ranged from $0.413(\mathrm{Q} 18)$ to $0.747(\mathrm{Q} 22)$. Communalities greater than 0.30 indicate that sample size is not likely to distort results. The initial EFA with no assumptions about the number of factors resulted in identification of five factors, as shown in the table of total explained variance (Table C10). Lattin et al. (2003) identify a cutoff eigenvalue of 1.00 for identifying factors. Another method for identifying the number of underlying factors is to locate the elbow on a scree plot where the graph has an inflection point. In Figure 7, the scree plot appeared to have elbows at three and five factors, the latter supporting the eigenvalue - based results. As indicated in Table C10, almost $54 \%$ of the variance was accounted for in the first five factors.


Figure 7. Scree plot showing elbows (inflection points) at three and five factors.

The next step was to examine a matrix of the factor loadings for manifest variables on these five factors, checking to ensure the matrix of factor loadings met the

Comrey and Thuney criteria, in order to determine which manifest variables loaded on which factors and to name or classify each factor (Table C11). Hair et al. provided guidelines for distinguishing significant factor loadings based on sample size. For a sample size of 350 with a power level of $80 \%$, loadings of 0.30 or more are considered significant. The component matrix for the initial EFA with no rotations showed 22 variables loading on the first factor, which appeared to exceed "only a few" described in Comrey's criterion 1, indicating the need for rotation of the solution. There were also 19 variables with cross-loadings (loadings with absolute values $\geq 0.300$ ). The combination of these characteristics indicated that a rotated component matrix might be more appropriate for the collected data. It is important to note that within this initial component matrix, factors three through five only have cross-loadings for variables whose primary loadings were on factors one or two.

Although the theoretical framework indicated that factors would be correlated, supporting the use of an oblimin rotation, all five of the possible rotations available in AMOS Graphics were run for models with five factors (based on the scree plot and total variance explained). A comparative summary of the results shown in these tables is provided in Table C12. Based on these results, an oblimin rotation was more appropriate than an orthogonal rotation in order to minimize cross-loadings. Due to the nature of the values in a Direct Oblimin pattern matrix (factor loadings tend to be negative numbers), and the more proportionate spread of variables across factors in the Promax pattern matrix, the Promax rotation was selected for continued examination. In both Direct Oblimin and Promax rotations, item 14 did not have any loadings with absolute values of at least 0.300 , so it was eliminated from the data set, and a new EFA was conducted. The
new correlation matrix determinant was $2.558 \times 10^{-6}(\mathrm{KMO}=0.915$, Bartlett's test of sphericity $X^{2}=4354.385$ with $d f=435$ and $p$-value $<0.001$ ), indicating the necessity for further review of the variables to determine if any additional items could be removed (to reduce multicollinearity so that the determinant would be greater than 0.00001 ). Five factors had eigenvalues of at least 1.000 , accounting for more than $54 \%$ of the variation (Table C13). The new pattern matrix (Table C14) showed slight changes in factor loadings (as compared to the previous results in Table C12), and item 18 had loadings with absolute values of at least 0.300 . Thus, this item was removed also, and a new EFA was conducted. With items $15 \mathrm{R}, 14$, and 18 removed, the correlation matrix determinant increased to $4.70 \times 10^{-6}\left(\mathrm{KMO}=0.914\right.$, Bartlett's test of sphericity $X^{2}=4152.472$ with $d f$ $=406$ and $p$-value $<0.001$ ), indicating there was still a need to reduce the number of variables. Five factors had eigenvalues of at least 1.000 , and more than $54 \%$ of the variation was explained (Table C15).

Examining the pattern matrix (Table C16) indicated that item 12 could be removed from further investigation as it did not have any loadings with absolute values of at least 0.300 . Additionally, factor five only had two major loadings. A subsequent EFA with item 12 removed (correlation matrix determinant of $8.717 \times 10^{-6}, \mathrm{KMO}=0.914$, Bartlett's test of sphericity $X^{2}=3947.473$ with $d f=378$ and $p$-value $<0.001$ ) resulted in a five-factor model (Table C17) with more than $55 \%$ of the variance explained. The Promax pattern matrix (Table C18) reflected seven cross-loadings with factor five only showing major loadings from two variables. Given that the eigenvalue associated with factor five was 1.000 , the first four factors account for more than $51 \%$ of the cumulative variance, and the scree plot had two inflection points (at 3 and 5 factors), consideration
was given to the possibility that a four factor model might be more appropriate for this data set. The resulting Promax pattern matrix (Table C19) showed only three crossloadings with two of the cross-loadings having absolute values less than 0.320 (sometimes considered a threshold for significant loadings). It is important to note that the loading and cross-loading ( 0.347 and 0.318 , respectively) for Q6 were very close in value indicating this survey item might be a candidate for removal from the analysis.

As the EFA results promoted a four-factor model, it was necessary to review the factor loadings in comparison to the seven factors developed in the conceptual model (motivation, leadership, vision, teamwork, flexibility, communication, and resources). The review indicated reassignment of survey items and subsequent re-naming of the factors. These reassignments are detailed in Appendix H. The survey items that loaded on Factor 1 appeared to link leadership and other constructs associated with high performing organizations that are related to a collaborative goal-oriented environment. Thus the factor was identified as leadership and collaborative environment. The survey items that loaded on Factor 2 appeared to link motivation to learning and instructional decision alignment. One item that was originally associated with vision included wording related to personal motivation, as did the item originally associated with learning. Thus the factor was identified as motivation and learning. The survey items that loaded on Factor 3 each describe an organizational process related to instruction or operations, so the factor was identified as organizational accountability. It should be noted that all six of the items loading on Factor 3 were written in negative form. The survey items that loaded on Factor 4 describe resource availability or decisions related to resources. Thus the factor was identified as resource availability.

Due to the modifications identified above, the conceptual model and related research questions and hypotheses were modified with the EFA results as follows. Research Question 1: Is the endogenous variable success predicted by the three exogenous variables (motivation and learning, leadership / collaborative environment, organizational accountability)? Are the parameter coefficients for each exogenous variable in the structural model significant?
$\mathrm{H}_{110}$ : The regression coefficient for the exogenous variable motivation and learning is equal to 0 .
$\mathrm{H}_{11 a}$ : The regression coefficient for the exogenous variable motivation and learning is greater than 0 .
$\mathrm{H}_{120}$ : The regression coefficient for the exogenous variable leadership / collaborative environment is equal to 0 .
$\mathrm{H}_{12 a}$ : The regression coefficient for the exogenous variable leadership / collaborative environment is greater than 0 .
$\mathrm{H}_{130}$ : The regression coefficient for the exogenous variable organizational accountability is equal to 0 .
$\mathrm{H}_{13 a}$ : The regression coefficient for the exogenous variable organizational accountability is greater than 0 .

Research Question 2: Is the endogenous variable resource availability predicted by the two exogenous variables (leadership / collaborative environment, organizational accountability)? Are the parameter coefficients for each exogenous variable in the structural model significant?
$\mathrm{H}_{210}$ : The regression coefficients for leadership / collaborative environment relating to resource availability is equal to 0 .
$\mathrm{H}_{21 a}$ : The regression coefficients for leadership / collaborative environment relating to resource availability is greater than 0 .
$\mathrm{H}_{220}$ : The regression coefficients for organizational accountability relating to resource availability is equal to 0 .
$\mathrm{H}_{22 a}$ : The regression coefficients for organizational accountability relating to resource availability is greater than 0 .

Research Question 3: Is there a model that better fits the data than the original structural equation model?
$\mathrm{H}_{30}$ : The original model provides the best fit for the sample data.
$\mathrm{H}_{3 a}$ : There is at least one post hoc model that is a better fit for the sample data.
The revised measurement model and structural model are shown in Figures 8 and 9, respectively.


Figure 8. Measurement model for CFA based on results of EFA.


Figure 9. Revised structural model based on results of EFA.

As a final step to the EFA, the manifest variables for each latent construct were evaluated using Cronbach's alpha testing. The results are shown in Table 5. All values were within the acceptable ( $>0.700$ ) and good ( $>0.800$ ) range. The only constructs producing Cronbach's alpha results between 0.700 and 0.800 , which might warrant review of the related manifest variables for possible elimination, were constructs associated with the minimum three variables, so no further reduction in the number of variables was made based on the EFA.

Table 5
Cronbach's Alpha Results for Latent Constructs

| Construct | Cronbach's alpha | Cronbach's alpha based <br> on Standardized Items |
| :---: | :---: | :---: |
| motivation / learning | 0.835 | 0.839 |
| resource availability | 0.729 | 0.730 |
| leadership / collaborative | 0.862 | 0.865 |
| environment | 0.838 | 0.841 |
| organizational accountability | 0.707 | 0.719 |
| successful program |  |  |

## Confirmatory Factor Analysis

The second phase of data analysis plan involved confirmatory factor analysis (CFA). Byrne (2010) provided a graphic to explain the relationship between the two components of SEM - evaluation of the measurement model as part of CFA and evaluation of the structural model (Fig. D1). Examination of the regression coefficients for the manifest variables identified in the revised model (Fig. 8), revealed that all of the coefficients were significant ( $p$-values $<0.001$ ), as shown in Table C20.

Though the regression coefficients for all manifest variables were significant, a review of GoF indices suggested the measurement model required some modification to be classified as good fitting ( $X^{2}=878.866$ with $d f=426$ and $p$-value $<0.001, \mathrm{CFI}=$ $0.893, \mathrm{RMSEA}=0.055, \mathrm{SRMR}=0.0624, \mathrm{PNFI}=0.745)$. The values for RMSEA , SRMR, and PNFI were within the acceptable range (RMSEA $<0.08$; SRMR $<0.08$, PNFI $>0.50$ ). However, the CFI was low (references indicate a minimum value of 0.90 should be achieved). Byrne (2010) advised investigating modification indices provided as part of the AMOS Graphics results for the measurement model. The first set of these
indices provide error covariances that the researcher might consider adding to the model. Byrne stated that pairs of errors with modification indices greater than 10.00 and par changes with absolute values of at least 0.100 should be considered for addition to the model, one-at-a-time. There were four error covariances with high modification indices and par changes with absolute values of 0.100 or very close to 0.100 (Table 6).

Table 6
Modification Indices for Error Covariances

| Error Covariance | Modification Index | Par Change |
| :---: | :---: | :---: |
| $\mathrm{e} 24 \leftrightarrow \mathrm{e} 20$ | 12.772 | 0.170 |
| $\mathrm{e} 32 \leftrightarrow \mathrm{e} 27$ | 13.266 | 0.100 |
| $\mathrm{e} 9 \leftrightarrow \mathrm{e} 22$ | 10.861 | -0.100 |
| $\mathrm{e} 7 \leftrightarrow \mathrm{e} 4$ | 31.703 | 0.091 |

Byrne explained that the modification index (MI) value is the amount the model $X^{2}$ would be reduced by adding the covariance. Although the greatest MI value was associated with the covariance between error terms for items 4 and 7, the par change was less than 0.100 . The error covariance with the greatest par change was between items 20 and 24 , so this was the first covariance added to the model. After each covariance was added, the model was run again, and GoF indices as well as modification indices were reviewed. Incremental changes to GoF indices are shown in Table 7. Upon adding the error covariance for items 4 and 7, the MI for items 9 and 32 rose to 12.024 with a par change of 0.093 . The par change for adding an error covariance for items 9 and 22 became more negative ( -0.101 ), so only the error covariance for items 4 and 7 was added. Upon adding the error covariance for items 4 and 7 and running the CFA again, the MI
for error terms for items 9 and 22 dropped below 10.00, and the absolute value of the par change dropped below 0.090 .

## Table 7

Incremental Changes to Goodness of Fit Indices

| Description | $X^{2}$ | $d f$ | $p$-value | CFI | RMSEA | SRMR | PNFI |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| original measurement model added | 878.866 | 426 | $<0.001$ | 0.893 | 0.055 | 0.0624 | 0.745 |
| $\begin{aligned} & \text { covariance } \\ & \text { e20 } \leftrightarrow \text { e24 } \\ & \text { added } \end{aligned}$ | 865.446 | 425 | $<0.001$ | 0.896 | 0.054 | 0.0620 | 0.746 |
| $\begin{gathered} \text { covariance } \\ \text { e27 } \begin{array}{l} \text { e32 } \\ \text { added } \end{array} \end{gathered}$ | 851.725 | 424 | $<0.001$ | 0.899 | 0.054 | 0.0613 | 0.747 |
| $\begin{gathered} \text { covariance } \\ \text { e4 } 4 \mathrm{e} 7 \\ \text { added } \end{gathered}$ | 817.386 | 423 | $<0.001$ | 0.907 | 0.052 | 0.0609 | 0.752 |
| covariance $\mathrm{e} 9 \leftrightarrow \mathrm{e} 32$ | 804.830 | 422 | $<0.001$ | 0.910 | 0.051 | 0.0603 | 0.753 |

At this point, there were no additional error covariances with MI and par change values in the range that Byrne suggested as signaling the need to add to the measurement model. Although some of the regression weight MI and par change values (provided by AMOS Graphics as part of the CFA output) reflected possible cross-loadings, no crossloadings were added to the model because these additions reduce the standardized regression weights for manifest variables below acceptable values for factor loadings. Because the measurement model is sometimes further modified during evaluation for
validity and reliability of constructs, a Bayesian analysis was delayed until after this examination.

Reliability and validity of constructs. Examination of convergent and discriminant validity and construct reliability revealed the need to remove some survey items to achieve or approach acceptable measurements for evaluation statistics. Items whose removal would make the most significant difference in evaluation statistics were examined before removal to minimize the effect of the loss of information associated with said items. In each case, wording of the item being removed appeared to be related closely enough to other items associated with the same factor that its removal was not likely to eliminate important information from the study. Additionally, since all of the participant comments were retained for the qualitative analysis, there would still be some part of the responses for each of these removed items included in the final discussion and conclusions, offsetting any loss of information in the statistical analysis. Items were removed one-at-a-time and evaluation statistics recalculated to minimize the number of items selected for removal. These results are shown in Table C21.

After removing three survey items, most of the indicators for model reliability and validity had improved. All factors had construct reliability (CR) values greater than the 0.7 threshold, suggesting the measurement model had high construct reliability. All factor loadings except for the loading for Q23 (0.494) were greater than 0.5 , indicating adequate convergent validity. Item 23 was left in the model so that resource availability would have three indicators (meeting the three-indicator rule described by Hair et al. (2010), as its loading was close to the 0.5 threshold. The average variance extracted (AVE) value for resource availability was greater than the advised threshold of 0.5,
suggesting adequate convergence. However, the remaining factors produced AVE values from 0.40 to 0.46 . Though these values were not greater than the rule-of-thumb threshold, they were either close ( 0.43 for organizational accountability and 0.46 for successful program) or had improved with removal of low-performing survey items (leadership / collaborative environment improved from 0.38 to 0.40 and motivation / learning improved from 0.39 to 0.40 ). At this point, removing any more survey items would exceed the recommended maximum of $20 \%$ and would likely lead to the loss of information important to the analysis, so it was noted that one convergent validity measure (factor loadings) indicated convergence for all factors except resource availability, while a second measure (AVE) indicated convergence for resource availability, possible convergence for organizational accountability and successful program, and possible convergence issues for leadership / collaborative environment and motivation / learning. In other words, "on average, more error remains in the [related survey] items than variance explained by the latent factor structure imposed on the measure" (Hair et al., p. 687).

Only resource availability $(\mathrm{AVE}=0.53>\operatorname{MSVs}$ of $0.40,0.33$, and 0.02$)$ and organizational accountability $(\mathrm{AVE}=0.43>\operatorname{MSVs}$ of $0.02,0.10$, and 0.22$)$ had high discriminant validity. Leadership / collaborative environment (AVE $=0.40>$ MSVs of 0.33 - resource availability and 0.10 - organizational accountability; AVE $=0.40<$ MSV of 0.73 - motivation and learning) showed partial discriminant validity. The same held true for motivation and learning $(\mathrm{AVE}=0.404>\mathrm{MSVs}$ of $0.21-$ organizational accountability and 0.403 - resource availability; AVE $=0.404<0.73$ - leadership / collaborative environment) showing partial discriminant validity. Two factors
(leadership / collaborative environment and motivation and learning) were truly distinct from both resource availability and organizational accountability but were not distinct from each other. Possible cross loadings for survey items associated with these factors were not included in modification indices tables in the SPSS AMOS Graphics output for the model. Thus, the measurement model met the criteria to be classified as an adequate to good-fitting model and met some of the criteria to be classified as having high construct reliability and adequate construct validity (some high, some low).

Bayesian analysis. The resulting model was then examined via Bayesian analysis. The model achieved convergence, producing a convergence statistic (CS) of 1.0018, which was less than the default cutpoint of 1.002 (Byrne, 2010). The software drew 69,501 samples (beyond the 500 discarded samples with which it begins; 1566 observations per second with acceptance rate of 0.85 ). Corresponding results from the ML estimation are shown in Tables C22 through C24 for comparison. Ninety-five and $99 \%$ confidence intervals were computed using the ML estimates and standard errors as well as the Bayesian estimates and standard deviations, recalling that Byrne (2010) commented that the Bayesian standard deviation emulated the ML standard error (Tables C25 through C30). All pairs of ML and Bayesian confidence intervals showed some overlap, indicating that the measurement model was not adversely affected by any nonnormality associated with Likert-scale survey items.

## Hypothesis Testing Results

After final modifications to the measurement model, the structural model was evaluated. The first step in examining the structural model involved review of the regression coefficients for the latent constructs, to evaluate research questions one and
two. These regression coefficients are shown in Table 8. The parameter estimates for leadership / collaborative environment and organizational accountability as predictors for success were not significant ( $p$-value $=0.356$ and $p$-value $=0.758$, respectively). Additionally, the parameter estimate for organizational accountability as a predictor for resource availability was not significant $(p$-value $=0.474)$. Given that the parameter estimates for leadership / collaborative environment as a predictor for success and organizational accountability as a predictor for resource availability were negative, these relationships were removed from the model, and it was run again. The parameter estimate for organizational accountability as a predictor for success continued to be insignificant $(0.037$ with $p$-value $=0.383)$, so it was subsequently removed. The remaining parameter estimates were significant (Table 9). Thus, there was sufficient evidence to reject $\mathrm{H}_{110}$ : The regression coefficient for exogenous variable motivation and learning (as a predictor for successful program) is equal to 0 , but not $\mathrm{H}_{120}$ : The regression coefficient for exogenous variable leadership / collaborative environment (as a predictor for successful program) is equal to 0 , nor $\mathrm{H}_{130}$ : The regression coefficient for exogenous variable organizational accountability (as a predictor for successful program) is equal to 0 . There was also sufficient evidence to reject $\mathrm{H}_{210}$ : The regression coefficient for leadership / collaborative environment relating to resource availability is equal to 0 , but not $\mathrm{H}_{220}$ : The regression coefficient for organizational accountability relating to resource availability is equal to 0 . It should be noted that when the related modifications were made to the model, variance terms for both the endogenous variables success and resource availability were significant ( 0.035 with $p$-value $=0.023$ and 0.157 with $p$-value $<0.001$, respectively).

Table 8
Regression Coefficient Estimates for Latent Constructs

|  |  |  | Estimate | S.E. | C.R. | P |
| :--- | :--- | :--- | ---: | :--- | :---: | :---: |
| successful_program | <--- | motivation_learning | 1.116 | .230 | 4.857 | $* * *$ |
| successful_program | <--- | organization_accountability | .016 | .051 | .309 | .758 |
| successful_program | <--- | leadership_collab_envir | -.189 | .205 | -.922 | .356 |
| resource_availability | <--- | leadership_collab_envir | .659 | .103 | 6.405 | $* * *$ |
| resource_availability | <--- | organization_accountability | -.031 | .043 | -.716 | .474 |

Table 9
Final Regression Coefficient Estimates for Latent Constructs

|  |  | Estimate | S.E. | C.R. | P |  |
| :--- | :--- | :--- | ---: | :--- | ---: | :---: |
| successful_program | <--- | motivation_learning | .967 | .093 | 10.405 | $* * *$ |
| resource_availability <--- | leadership_collab_envir | .640 | .098 | 6.509 | $* * *$ |  |

After evaluating the regression coefficient estimates for the structural model, the covariances between latent constructs were examined. All of the estimated covariances were significant with $p$-values $<0.001$ (Table C33). The GoF indices for this model were reviewed and are compared to the initial structural model in Table 10. Though there were slight increases in the SRMR, it was still less than the 0.80 threshold. Additionally, the PNFI increased (due to the reduction in estimated parameters), indicating a better-fitting model.

Table 10
Goodness of Fit Indices for Structural Model

| Model | $X^{2}$ | $d f$ | $p$-value | CFI | RMSEA | SRMR | PNFI |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| initial | 660.40 | 338 | $<0.001$ | 0.917 | 0.052 | 0.0605 | 0.755 |
| after |  |  |  |  |  |  |  |
| removal of <br> insignificant <br> parameters | 662.60 | 341 | $<0.001$ | 0.917 | 0.052 | 0.0606 | 0.761 |

The final research question focused on the possibility that post hoc analysis might produce a better fitting model. Given that the only exogenous variable remaining as a predictor for success was motivation and learning, a model was generated that altered the relationships between latent constructs. Leadership / collaborative environment, organizational accountability, and resource availability were treated as exogenous variables for motivation / learning (making it an endogenous variable although it remained exogenous for the endogenous variable success). Modifications were made so that leadership / collaborative environment, organizational accountability, and resource availability had covariances, and a variance term was added for motivation / learning. The resulting model produced the best set of GoF indices, with only a slight decrease in PNFI as compared to the first structural model with all parameter estimates significant (Table 11).

## Table 11

Goodness of Fit Indices for Post Hoc Structural Model

| Model | $X^{2}$ | $d f$ | $p$-value | CFI | RMSEA | SRMR | PNFI |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| after removal <br> of |  |  |  |  |  |  |  |
| insignificant <br> parameters | 662.60 | 341 | $<0.001$ | 0.917 | 0.052 | 0.0606 | 0.761 |
| new model <br> with |  |  |  |  |  |  |  |
| modifications <br> to latent <br> construct <br> relationships | 645.910 | 339 | $<0.001$ | 0.921 | 0.051 | 0.0590 | 0.760 |

No subsequent modifications produced models with equivalent or better GoF measurements. Thus, this model was recognized as the best fitting model for the collected data, providing sufficient evidence to reject $\mathrm{H}_{30}$ : The original model provides the best fit for the sample data. The final model is shown in Figure 10. The regression coefficients, variances, and covariances for this model are shown in Tables C31 through C33.


Figure 10. Final model with parameter estimates.

## Summary

Evaluation of the collected data began with examination of individual survey items. Subsequent evaluation of the inter-item correlation matrix led to elimination of item 15 which had been flagged during the descriptive analysis as potentially problematic due to response results that were not similar to the patterns for other items. Application of the EFA procedure led to removal of three additional survey items, 12,14 , and 18. Subsequent CFA of the measurement model provided results that led to the further
removal of three items, 6,11 , and 26 , and additional of four error covariances. The resulting measurement model met the criteria to be classified as an adequate to goodfitting model and some of the criteria can be classified as having high construct reliability and adequate construct validity (some high, some low). Though this model only had adequate construct validity, consideration of the themes that emerged in qualitative analysis of participant comments supported evaluating the structural model with SEM. Significance of regression coefficients in the structural model was examined, leading to rejection of only two of the five null hypotheses associated with the first two revised research questions. A post hoc analysis revealed a better fitting model for the sample data, leading to rejection of the null hypothesis associated with the third revised research question.

## CHAPTER V <br> DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This research project was designed to examine underlying factors associated with successful aviation / aerospace / engineering career education academies and programs. It began with a focus on career academies only but expanded to include a wider variety of school- and community-based programs. The research methodology, SEM, was selected because it is most appropriate for investigating relationships between underlying factors that are represented by other measured variables. In this case, the measured or manifest variables were 35 Likert-scale items that participants responded to via an online, anonymous survey. A deep investigation into organizational design theory allowed for development of a hypothesized model for testing with collected data. Though SEM is a numerical procedure, multiple researchers (Blunch, 2013; Byrne, 2010; Schumacker \& Lomax, 2016) recognized that the procedure was robust enough to work with categorical data.

## Discussion

A descriptive statistics review of the survey item responses suggested generally positive attitudes toward academies / programs. All items written as positive statements showed the highest frequencies in responses of agree or strongly agree. Most items written as negative statements showed the highest frequencies in responses of disagree or strongly disagree, indicating positive sentiments related to the participant's academy / program. However, there were three items written as negative statements that produced a wider variability in survey responses. The item with the most unexpected responses was item \#15R: In my academy / program, there are specific groups of people that have better
access to information we all need. The expectation was that a majority of participants would disagree with this statement. However, the opposite occurred. Half of all participants chose either agree or strongly agree as their response. There was also an unexpected trend in responses for item \#20R: In my academy / program we have power struggles that affect how well we achieve our goals and objectives. Though the highest frequency was associated with the expected choice of disagree ( $34.6 \%$ ), almost the same proportion (33.7\%) chose either agree or strongly agree. This phenomenon occurred once more with item \# 24R: Resources are not always used for activities that align with the academy / program vision. The highest frequency was associated with the expected choice of disagree (36\%), but $30.9 \%$ selected agree or strongly agree. It may be important to note that the only three survey items that produced unexpected results were all items written in a negative format. Additionally, the variability in these responses may have influenced some of the statistical results in hypothesis testing.

The initial hypothesized model was based on a theoretical framework founded in organizational design and components associated with success in the theoretical model developed from the extant literature: Motivational Theory of Modern Expectancy-Value; Organizational Development Theory; High-Performance Culture Theory; and the Theory of Organizational Excellence. Because the survey instrument used for data collection was a new measurement tool, EFA was performed on the manifest variables (survey items) to consider the relationships included in the theoretical model. During the process of validating conditions for EFA, survey item 15R: In my academy / program, there are specific groups of people that have better access to information we all need, was removed. The first set of EFA results produced a five-factor model, which was different
from the original hypothesized model. Subsequent EFA iterations, involving an Oblimin Promax rotation, resulted in the removal of three additional survey items: 14: When I have a question or concern about my academy, I can get answers or responses quickly; 18: People who have different skills, knowledge, or talents, work together to make the best decisions for my academy; and 12: Decisions about my academy are made by the people who have the best information possible. By removing these items, it was possible to reduce the number of underlying factors to four. Examination of the survey items associated with each of the factors led to their classification as leadership and collaborative environment, motivation and learning, organizational accountability, and resource availability. It may be significant to note that all of the survey items written as negatives loaded on the organizational accountability factor. Only the fourth factor, resource availability, retained characteristics of one of the originally hypothesized latent variables. The first three each included characteristics of more than one of the originally hypothesized latent variables, reflecting a possible difference in how organizational design characteristics are perceived in career education settings. Based on the EFA results, a new hypothesized model, with corresponding modifications to the original research questions and hypotheses, was designed for further analysis.

The next step in the analysis process was CFA. Investigation of modification indices produced as part of the CFA led to the addition of four covariances between error terms for survey items 20R: In my academy / program we have power struggles that affect how well we achieve our goals and objectives and 24R: Resources are not always used for activities that align with the academy / program vision; 27: Everyone (students and / or adults) in my academy / program is involved in lifelong learning to increase their
related skills, knowledge, or talent and 32: I believe everyone involved with my academy/ program (students and / or adults) plays a part in making my academy / program better (with respect to the vision statement, goals, and objectives; 4: Decisions about my academy / program are aligned with the vision statement and 7: The things I participate in that are related to my academy / program seem to be aligned with the vision statement; and 9: Leaders (students and / or adults) regularly interact with members of my academy / program to involve us in planning and decisions and 32: I believe everyone involved with my academy / program (students and / or adults) plays a part in making my academy / program better (with respect to the vision statement, goals, and objectives). The first of these covariances showed a connection between perceptions of how decisions were being made within academies / programs. The second indicated a link between perceptions of personal and organizational continuous improvement. The third showed a connection between decision-making and academy / program activities, while the fourth indicated a link that might be interpreted as collaborative leadership leading to organizational improvement.

Examination of GoF indices and recommended threshold criteria for reliability and validity measures resulted in the removal of three additional survey items: 11: When someone involved with my academy / program (students and / or adults) does not meet their responsibilities, they know they will be held accountable; 26: My academy / program provides opportunities for me to improve my related skills, knowledge, or talents, if I want to participate; and 6: There is a system in place to measure my academy's / program's progress according to our vision statement. The resulting measurement model included 28 manifest variables predicted by five latent constructs.

This model met the GoF criteria to be classified as an adequate to good-fitting model and some of the criteria to be classified as having high construct reliability and adequate construct validity (some high, some low).

Because the data used in this analysis were categorical, an additional Bayesian analysis was run on the final measurement model to address a concern about the normality assumption for SEM. The Bayesian model converged and regression coefficients for manifest variables, their variances, and the model covariances were very close to those generated by the maximum likelihood method. Confidence intervals at the $95 \%$ and $99 \%$ levels were generated and in every case they overlapped.

The results of the EFA and CFA included finding that the original survey instrument was not appropriate for analyzing organizational design constructs underlying aviation / aerospace / engineering career education programs. This instrument was developed from item samples included in instruments traditionally used to evaluate business organizations. Survey items that remained in the model after CFA was completed comprise a new instrument that would be appropriate for use in further analysis of these types of career education programs. These results further impacted the initial hypothesized model. The measurement model was modified due to the reduction in survey items as well as in identification of four factors rather than the originally expected seven.

After completing the CFA, the next step was examining the structural model. Investigation of predictive relationships between the four new factors and success revealed that only the factor labeled motivation and learning produced a significant relationship with successful program. Thus, one null hypothesis $\left(\mathrm{H}_{110}\right)$ associated with
(revised) Research Question \#1 was rejected while there was insufficient evidence to reject the remaining two null hypotheses $\left(\mathrm{H}_{120}\right.$ and $\left.\mathrm{H}_{130}\right)$. These results lead to a conclusion that the most appropriate model to fit the sample data was a third-order model. The answer to Research Question \#1 was that motivation and learning is a significant predictor for the variable successful program.

Research Question \#2 $2_{\text {new }}$ examined the relationship between two exogenous variables (leadership / collaborative environment and organizational accountability) and the endogenous variable resource availability. Only leadership / collaborative environment was significant as a predictor for resource availability. Thus, one null hypothesis $\left(\mathrm{H}_{210}\right)$ was rejected while there was insufficient evidence to reject the remaining null hypothesis $\left(\mathrm{H}_{220}\right)$.

The final new research question addressed the possibility of a better fitting model. After removing predictive indicators between two of the three exogenous variables and the endogenous variable successful program, as well as one of the exogenous variables and the endogenous variable resource availability, there were still modifications that might make the model better in post hoc analysis. Possible changes in relationships between latent constructs were explored with analysis including review of regression coefficient, variance, and covariance estimates for significance and review of GoF indices. Because analysis of participant comments (see next section) reflected a very strong underlying theme of motivation being directly related to success, one post hoc model included modification of the structural components associating latent constructs. Further blending of the qualitative analysis results and post hoc model generation led to changes in classification of the latent constructs. The covariances between motivation
and learning and other factors (leadership / collaborative environment and organizational accountability) were replaced with paths leading from those factors to motivation and learning. Additionally, a path was created from resource availability leading to motivation and learning. The themes identified in the qualitative analysis indicated that motivation and learning might be related to all three of these latent constructs but that it alone was directly related to success. After making these modifications to the structural model and converting resource availability to an exogenous variable (removing the path from leadership / collaborative environment and adding covariances between leadership / collaborative environment and resource availability and between organizational accountability and resource availability), a new model produced the best GoF indices achieved. This model provided sufficient evidence to support the alternate hypothesis for Research Question $\# 3_{\text {new: }}$ : There is at least one post hoc model that is a better fit for the sample data.

Analysis of participant comments. There were a few recurring themes across comments made by participants for multiple survey items. The most dominant theme related success to motivation for both student and adult stakeholders. Collaboration, alignment, and communication were also topics that repeated across survey item comments. These four themes were included in both positive and negative comments about academies / programs. An additional topic that appeared repeatedly as part of negative comments or as a quantifier that neutralized generally positive comments was a concern for lack of funding that was also tied to limited or outdated resources.

Motivation was the most often repeated theme underlying both positive and negative comments across multiple survey items. Perhaps one of the most positive
comments in which the participant indicated strong motivation was one alumnus who wrote, "I would LOVE to help bring back the TSA chapter at my former school." He explained that as a student he had not been as involved in his academy as some other students, but on looking back, he believed his experiences with the TSA chapter had been some of the most influential in his more recent successes. Participants described how involvement in their academies / programs facilitated their personal motivation to become more focused or involved. Adult stakeholders suggested that their participation involved both "teaching and learning," and volunteering was "an investment in the community as well as on oneself." Challenges associated with this theme focused on maintaining student motivation between initial involvement and earning a leadership role and integrating varying levels of stakeholder motivation in a single academy / program. One adult in a leadership role explained a personal issue related to motivation, "I have trouble helping people who aren't willing to help themselves." This sentiment was echoed in other comments by adult stakeholders, as well as some students who explained that there were students who were assigned to their academy by school personnel even though they appeared to have "no interest in engineering." In some cases, motivation was tied to accountability with participants indicating varying levels of motivation among volunteers being matched by varying levels of accountability.

Another recurring theme was collaboration. In academies / programs where stakeholders responded positively, they described strong vertical and horizontal collaborative efforts through comments such as "we have worked extensively with school district leadership and several community organizations," "the executive group has think tanks made up of subject experts" or "our teachers keep us up to date, ask us what we
think, and use our opinions to aid in making decisions pertaining to the future of the academy." One industry member / program mentor commented that having collaborative expectations "is critical, especially [involving] parents," while a school-based adult recognized that facilitating student involvement in the TSA at the state level required a "shared responsibility ... cornerstone." Another suggested that active research within the organization enabled data-driven decisions that involved program-wide feedback. There were also negative comments that suggested the importance of collaboration, such as "the disconnect is with the powers that be outside of our local area." Another participant indicated that planning decisions for their organization were "compartmentalized," indicating a lack of collaboration. This sentiment was also expressed by a stakeholder in a multi-site program who believed that operational decisions were made by those individuals who implemented related actions but that strategic planning was developed by "people who have competing information" which tended to cause decisions to be less than effective.

Because some of the survey items were designed to investigate alignment with the organizational vision statement, the theme of alignment was evident in many comments. Remarks indicated that most academy / program activities and assessments were aligned with the goals and objectives associated with a vision statement. These included "in my aviation classes, almost everything is aligned with the end goal of earning industry certification." However, some participants indicated a concern for administrative requirements (one adult stakeholder described these as "minutia") that at times " $\mathrm{g}[\mathrm{o}] \mathrm{t}$ in the way of the meat of the program." This concern with external requirements and parameters, or a disconnect between academies and district level oversight or local
programs and state, regional, or national organizations was echoed across multiple survey items. In several cases, participants held positive perceptions of the stakeholders with whom they came in direct contact but believed those beyond their specific location were not always "on the same page" with respect to goals and objectives, as well as strengths and challenges, at the local level.

A recurring theme in items that referenced interaction between stakeholders was communication. Both positive and negative aspects of communication were described. In general, participants believed that important information was available and communicated via multiple platforms. They described some of the challenges associated with communication in organizations of different sizes, expressing the opinion that improving communication was a constant process. However, they noted that individual stakeholders needed to shoulder responsibility to seek information and ask questions. Comments like "it requires initiative" or "take the time to learn [information]," returned to the theme of personal motivation.

The most common theme in negative comments, other than lack of motivation, referenced limited funding and resources. A lack of adequate funding was seen as a reason for shortfalls that affected student participation, from outdated textbooks and technology equipment to a lack of a program's ability to adapt to rapid changes in the industry. Participants described "scrounging" for equipment and spending time doing fundraisers instead of focusing their efforts on instruction and learning. Some of these negative comments accompanied positive comments about stakeholders finding ways to enhance instructional opportunities using "whatever was on hand." Additional statements about limited personnel resources generally described recurring vacancies in
both school and community programs, and indications that increasing the size of an organization's student body as well as its instructional faculty would result in greater achievement of goals and objectives associated with academy / program vision.

Issues that arose during the study. One of the earliest issues in the research was the difficulty in collecting a large enough sample of completed surveys. Personal requests from the research to former colleagues or peers in the career education field, as well as later personal contacts with leaders in community-based or other programs via email or telephone call, proved most effective in finding support from individual academies / programs to encourage stakeholders to participate in the survey. The issue of meeting sample size was compounded by participants who completed most of the survey items (leaving as few as one blank) and the demographic items. In the initial research plan, because SEM requires all fields having values, the decision was made to eliminate cases that had missing data for the survey items. There were at least 100 cases that were eliminated during the data collection phase for lack of completed surveys. In most of these cases, fewer than four survey items were missing data.

It is very important to note that the original hypothesized model was developed with the intent to limit survey participants to stakeholders in aviation / aerospace / engineering career academies in high school settings. Because of the difficulty with collecting enough survey response data, the sampling pool was expanded to include stakeholders in aviation / aerospace / engineering college dual enrollment programs, JROTC programs that had aviation / aerospace / engineering components, and community-based aviation / aerospace / engineering programs such as Civil Air Patrol, Girls Code, and programs run by aviation professional groups such as the Black Pilots

Association or Women in Aviation, International. This expansion seemed acceptable given that there were three survey items associated with success, so participants who were involved with a program that might not have met the criteria for success used originally (i.e., NCAC National Model recognition) were expected to use a wider variety of responses. However, the expansion may have made enough of a significant change to the study that it could be a primary reason for the difference between the expected latent constructs identified in the conceptual model and the latent constructs that were derived from the collected data using EFA. Removing the homogeneity of the sample offered a wider variety of participants, which reduced bias due to geographic location, may have created a different problem.

Another issue that developed was associated with missing data. As stated above, cases with missing survey responses were eliminated. However, there were cases with complete sets of responses to survey items but incomplete demographic information. This phenomenon did not hinder the hypothesis testing procedure nor the qualitative analysis of participant comments, but any further evaluation of responses with respect to demographic groups would be very limited. Without the missing information, it is impossible to discern if there might be trends in responses associated with disaggregated demographic subgroups. Many of these subgroups were too small to be considered a representative sample of the demographic descriptors. Generally, a threshold of 30 subjects per demographic silo is desired so that the $X^{2}$ independence test assumption of a minimum frequency of five per cell in a two-way table of expected values can be achieved. The subgroups that did not meet a minimum threshold of 30 are shown in Table C34. It was difficult to discern any possible trends or significant associations due
to the small sizes in so many subgroups. Collapsing rows or columns in an attempt to perform $X^{2}$ analysis might have created an issue of data integrity, and true associations or significant differences between subgroups might have been missed.

## Conclusions

The hypothesis testing results suggested that the most important factor in predicting success for an aviation / aerospace / engineering academy or program is personal motivation related to learning. Though other underlying factors were clearly related to perceived academy / program success, they appeared to have indirect relationships with success. These final exogenous factors (leadership / collaborative environment, organizational accountability, and resource availability) were somewhat related to the latent factors identified in the original model (teamwork, vision, leadership, flexibility, communication, learning, and resource management), but two of the three (leadership / collaborative environment and organizational accountability) seemed to be combinations of components of these variables rather than disaggregated constructs. The final construct associated with resources focused more on availability than on management, which was even more clearly defined in additional comments by participants.

Theoretical contributions. Perhaps one of the important conclusions that can be drawn from the results is that success of a learning organization is directly related to personal motivation of its stakeholders, and that motivation can be impacted by interrelated combinations of constructs identified in the literature associated with the theoretical frameworks related to organizational design and excellence. Other factors drawn from the literature on organizational design that appear to have a direct
relationship with motivation and learning and, by extension, an indirect relationship with program success are leadership / collaborative environment, organizational accountability, and resource availability.

Motivation was the most commonly recurring theme in comments, indicating its predictive strength for an organization's success. Additional themes of collaboration, vision / alignment, and concerns regarding limited resources and funding, are directly associated with the remaining three exogenous variables (leadership / collaborative environment, organizational accountability, and resource availability, respectively) in the final model. A theme of communication corresponds to one of the latent variables in the original model but could also be associated with collaboration in the final model. The identification of, and association between, these underlying constructs should add to the body of research on organizational design, focusing on educational or learning organizations and specifically concentrating on career education programs with aviation, aerospace, and / or engineering themes.

Participants' criticisms. The analysis of participant comments involved review of optional comments provided by survey participants. The remarks provided by some participants indicated an overall satisfaction with academies / programs, but there were some very specific criticisms. Considering that the comments were voluntary (so the researcher would expect a typical trend of more negative than positive specific comments), these criticisms indicated that most concerns of participants seemed to be with lack of resources - with the most common deficiencies in funding and updated technology. This significant criticism may be why making resource availability an exogenous variable covarying with leadership / collaborative environment and
organizational accountability and adding the path between resource availability and motivation / learning led to the best fitting model for the sample data. There was also a concern among some adults that the academies / programs with which they were associated were hindered by educational criteria or organizational bureaucracy. Though study participants expressed concerns about perceived deficiencies associated with their respective programs, they tended to include the caveat of a consistent positive theme related to efforts by teachers, program mentors, and other individuals to support academy / program participants in achieving their goals. This theme resonates with scaffolding individual motivation to succeed, which then leads to the academy's / program's success.

Practical contributions. The results of this research study can provide a guide for stakeholders interested in designing a new aviation / aerospace / engineering career education academy or program. Participant comments, written in a general manner, would enhance such a guide with ideas for components of a successful program and possible pitfalls to avoid. However, as the survey and comment results indicated in this study, personal motivation is the most important factor in creating a successful academy / program. Thus, it would be imperative to develop as deep an understanding as possible of the potential population for a new academy / program as an early step in design, so that individuals would be motivated to join the academy / program, stay with it, and become productive stakeholders themselves.

The data collected in this study offered a plethora of information about aviation / aerospace / engineering career education. It should serve as a springboard for continued study of how to facilitate successful educational programs for secondary students so that
these industries and their workforce pipelines thrive. It should also engender additional research into how and why these results occurred.

## Limitations of the Findings

Because survey participants self-selected, this study was based on voluntary response data which can lack generalizability to the population. There were no opinion responses to individual survey items, but it is difficult to determine if an individual chose no opinion because they truly had no opinion or because they had a neutral opinion. It is also impossible to estimate the opinions of academy and program stakeholders who were invited but chose not to participate in the study. It is possible that stakeholders in academies or programs that were not identified for the study would have opinions that differ significantly from those offered by the individuals who did participate in the study.

A further limitation was related to missing information. Because Likert-scale items are ordinal data, it is generally considered inappropriate to impute values for missing data. The EFA procedure ignores all data for a case that has a missing value for any individual variable. For this reason, all cases that had missing data were removed from the data set before any analysis was performed. It is possible that information pertinent to hypothesis testing was lost in the removal of these cases. To mitigate the loss of information, all comments by these participants were retained for qualitative review.

## Recommendations

The first recommendation is concerned with the survey instrument itself. Survey response choices should be readdressed. Combining the issue of possible multiple meanings for the no opinion response with the issue of missing values in some cells making an entire case useless, it might be better to revise the choices to the following: no
opinion, strongly disagree, disagree, neutral, agree, strongly agree. After data collection, an additional level, no response, could be added for missing data. EFA, CFA, and SEM procedures rely on numerical values, so the levels need to be converted to numbers. Strongly disagree could be coded -2 to show a negative response, disagree could be coded -1 to show a negative response, neutral, no opinion, and no response could be coded 0 with the addition of a dummy variable to flag the no-opinion responses and the non-responses, agree could be coded +1 , and strongly agree could be coded +2 . If the scale requires all positive values, no response should be coded 0 (creating a dummy variable), and the scale should start with strongly disagree at 1 as was the case in this research. In this manner, all submitted surveys could be used for analysis. It would also allow for reducing bias that may have been introduced here through elimination of cases with incomplete surveys. Although it is generally ill-advised to impute categorical variables, some consideration could be given to imputation of missing values through clustering cases based on responses to other items and demographic responses. Additional analysis methods could be applied to data recorded in this manner that might help develop a better understanding of the relationships between manifest variables and underlying constructs and between the constructs themselves.

Another consideration would be to use a large sample from the population of academy / program stakeholders to reevaluate the survey items to consider which items might be redundant. Software programs like SAS and SPSS Basic offer procedures which researchers can use to reduce the number of variables under consideration in a study. One of these methods is clustering - for the data collected by this measurement instrument, the procedure would cluster survey items (similar to factor analysis, but with
the target of success under consideration) in groups that appear to describe the same idea. Using the percent of explained variation as an index, one can choose the best item within a cluster to represent that cluster and reduce the overall number of survey items. Making the survey instrument shorter might improve completion rates, increasing sample size. Additionally, by clustering survey items, it might be possible to create different versions of the survey using different items from each cluster.

Recommendations for the target population. The first recommendation related to the target population is that the research be replicated with a homogeneous sample of stakeholders in high school academies only. Over the course of this study, new schoolbased programs have been implemented, and programs that were about to begin during the data collection phase are now more well-established. It should be possible to develop a sampling frame that includes career academies across most (if not all) states. It would be advantageous to then add a demographic question about the region of the country in which the survey participant is located. A much larger sample size (the goal should be at least ten times the size of the sample used here) should be used, so that the research can take a closer look at potentially significant differences between subgroups. In order to create a sample of at least 3500 participants, the best practice would be for the researcher (or research team) to visit schools wherever possible so that presentations to stakeholders could create a somewhat personal connection that could lead to higher participation rates. It would also be advantageous to ensure that both the student subgroup and the adult subgroup have sample sizes of at least 350 for a new study involving only school-based career academies. If different subpopulations based on program type are used (i.e., high school career academies, high school JROTC, dual enrollment academies / programs that
are aviation / aerospace / engineering focused), the analysis should be completed for each subpopulation separately. A comparison of these results might be more helpful to school and program leaders in focusing their limited resources where they can have the greatest return on investment. Similarly, the original conceptual model should be re-evaluated for individual community programs that have participation levels large enough to generate a sample of at least 350 completed surveys. Some programs, such as Civil Air Patrol or the FAA - AICE program are nationwide so there should be large enough sampling frames to separate these populations for better model fitting. One suggestion would be to use new data from a more homogeneous sampling frame and investigate whether it fits the original hypothesized model or the final hypothesized model better.

Recommendations for future research. Given the result that personal motivation was the most closely related construct to academy / program success, further (and perhaps expanded) study of stakeholder motivation should be undertaken. When this phenomenon is combined with the realities of increased aviation / aerospace / engineering workforce demands and continued disparity between population demographics and the demographic of individuals in the workforce pipeline for these three industries, it is evident that research should involve questions of what motivates students (especially those in traditionally underrepresented demographic subgroups) to become and remain involved in career education academies / programs that focus on aviation / aerospace / engineering curricula. To facilitate deeper understanding of program faculty and staff motivation research should involve investigating instructional training and experience as well as "the why" associated with a desire to work in secondary aviation / aerospace / engineering programs. Subsequent study of individuals
who are employed in these industries should investigate what, if any, secondary career education opportunities they may have participated in and how those opportunities shaped their learning as well as their personal career trajectories.

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## APPENDIX A

Permission to Conduct Research

## EMBRYFIDDLE

Aeronautical University.
DAYTONA BEACH, FLORIDA

Dean of Research and Graduate Studies Tel: 386-226-7059 Hicke0b5@erau.edu

April 1, 2016
Susan Archer
Adjunct Faculty
Worldwide
Reference: Institutional Review Board Approval - 16-117
Examining the Organizational Design of Successful Secondary Aviation/Aerospace Career Academics

## Dear Susan Archer:

In compliance with Embry-Riddle Aeronautical University's policy on Human Subjects and PHS 45 CFR 46.110, in my capacity as Chair of the Institutional Review Board, the Institutional Review Board has reviewed the Plan for the Protection of the Rights and Welfare of Human Subjects for the proposed research project entitled Examining the Organizational Design of Successful Secondary
Aviation/Aerospace Career Academics and has determined that this research provides minimal risks to the participants. Therefore, you may proceed with your research as written in the IRB Protocol application on file.

Approval of this project expires on March 22, 2017. Should you wish to continue this research after that date please apply for a reauthorization/extension at least one month prior to expiration date. Any significant systematic deviation from the approved protocol must be submitted to the IRB for approval prior to implementation and any adverse events must be reported to the IRB promptly.

Best of luck in your endeavors.

Sincerely,

## MBMegatchy

## M.B. McLatchey

Chair of the Institutional Review Board
for the use of Human Subjects in Research

Cc: Dr. Michael Hickey, IRB Director
Institutional Official


600 S. Clyde Morris Blvd. Daytona Beach, FL 32114-3900 embryriddle.edu

# Embry-Riddle Aeronautical University Application for IRB Approval Expedited Determination 

Principle Investigator: Susan Archer Other Investigators: David Esser
Role: Student
Campus: Daytona Beach College: COA

## Project Title: Structural Equation Modeling of Successful Secondary Aviation/Aerospace/ Engineering Education

Submission Date: 2/1/2017 Determination Date: 2/12/2017 Review Board Use Only
Exempt: Yes Approved:

| Waind 3. Thaf |  | February 27, 2017 <br> Expires: February 26, 2018 |
| :--- | :--- | :--- |
| Pre-Reviewer Signature | M.B. McLatchey |  |
| Chair of the IRB Signature | Date of Approval / <br> Expiration Date |  |

Brief Description: This study will examine successful aviation/aerospace/engineering programs' organizational design, with the goal of developing a set of effective structural equation models that can be used to provide guidance that could be used by new and fledgling programs, as well as programs looking to reboot at the organizational level, in or to become successful. The study employs an online survey for stakeholders in secondary aviation, aerospace, and engineering career academies and programs. This is an extension of the same study approved at full IRB 16-117 that expires 3-23-17. The PI needs more time to receive more responses.

This research falls under the expedited category as per 45 CFR 46.110 (b) because one or both of the following apply:
(1) $\square$ some or all of the research appearing on the list below are found by the reviewer(s) to involve no more than minimal risk,
(2) $\boxtimes$ minor changes in previously approved research during the period (of one year or less) for which approval is authorized.

Research activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the following categories. The activities listed should not be deemed to be of minimal risk simply because they are included on this
list. Inclusion on this list merely means that the activity is eligible for review through the expedited review procedure when the specific circumstances of the proposed research involve no more than minimal risk to human subjects. (Bankert \& Amdur 2006)

1. $\quad \square$ Prospective collection of biological specimens for research purposes by noninvasive means.
$2 . \boxtimes$ Collection of data from voice, video, digital, or image recordings made for research purposes.
2. $\square$ Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects 45 CFR $46.101(\mathrm{~b})(2)$ and (b)(3). This listing refers only to research that is not exempt.) [This means research that presents more than minimal risk to human subjects.]

Bankert, E. A., Amdur, R. J., (2006) Institutional Review Board Management and Function, Second Edition, pp. 517-518.

## EMBRYRIDDLE

Aeronautical University.
DAYTON BEACH, FLORIDA
Dean of Research and Graduate Studies Tel: 386-226-7059
Hicke0b5@erau.edu

March 1, 2018
Susan K. Archer, Ed.D.
Instructor, Worldwide College of Arts and Sciences

Reference: Institutional Review Board Approval - 18-085
Structural Equation Modeling of Successful Secondary Aviation/Aerospace/
Engineering Education

Dear Dr. Archer:

In compliance with Embry-Riddle Aeronautical University's policy on Human Subjects and PHS 45 CFR 46.110, in my capacity as Chair of the Institutional Review Board, the Institutional Review Board has reviewed the Plan for the Protection of the Rights and Welfare of Human Subjects for the proposed research project entitled Structural Equation Modeling of Successful Secondary Aviation/Aerospace/
Engineering Education and has determined that this research provides minimal risks to the participants. Therefore, you may proceed with your research as written in the IRB Protocol application on file.

Approval of this project expires on February 26, 2019. Should you wish to continue this research after that date please apply for a reauthorization/extension at least one month prior to expiration date. Any significant systematic deviation from the approved protocol must be submitted to the IRB for approval prior to implementation and any adverse events must be reported to the IRB promptly.

Best of luck in your endeavors.


Chair of the Institutional Review Board
for the use of Human Subjects in Research

Cc: Dr. Michael Hickey, IRB Director Institutional Official


## APPENDIX B

Data Collection Device

The following survey items were included in a SurveyMonkey.com online survey.
Items will be presented to participants in random order. Each item included five Likert scale response choices (Strongly Disagree, Disagree, No Opinion, Agree, or Strongly Agree) and a comment box for additional information (for individual participants who chose to expand upon a particular response).

1. I believe that I can be successful as a participant in and / or contributor to my academy / program.
2. I believe my effort / participation level with respect to my academy / program directly affects how well I achieve my expectations.
3. I believe that participating in and / or contributing to my academy / program is a valuable experience (with respect to my personal goals).
4. Decisions about my academy / program are aligned with the vision statement.
5. Daily activities / processes within my academy / program are not aligned with the vision statement.
6. There is a system in place to measure my academy's / program's progress according to our vision statement.
7. The things I participate in that are related to my academy / program seem to be aligned with the vision statement.
8. Leaders (students and / or adults) help everyone work to achieve the goals and objectives of my academy / program.
9. Leaders (students and / or adults) regularly interact with members of my academy / program to involve us in planning and decisions.
10. Everyone involved with my academy / program (students and / or adults) is expected to contribute to the academy's / program's success.
11. When someone involved with my academy / program (students and / or adults) does not meet their responsibilities, they know they will be held accountable.
12. Decisions about my academy / program are made by the people who have the best information available.
13. Important information about my academy / program is communicated to everyone in a timely manner.
14. When I have a question or concern about my academy / program, I can get answers or responses quickly.
15. In my academy / program, there are specific groups of people (e.g., seniors who have been in the academy / program for four years, or math teachers) have better access to information we all need.
16. The way information is presented for my academy / program makes it difficult to understand.
17. We use teamwork to get work done in my academy / program.
18. People who have different skills, knowledge, or talents, work together to make the best decisions for my academy / program.
19. Everyone involved with my academy / program (students and / or adults) is able to have input about what we do and the direction we are going.
20. In my academy / program we have power struggles that affect how well we achieve our goals and objectives.
21. We have the supplies and material resources we need to meet the goals and objectives of my academy / program.
22. We have the technology and equipment resources we need to meet the goals and objectives of my academy / program.
23. We have the people (students and / or adults) we need to meet the goals and objectives of my academy / program.
24. Resources are not always used for activities that align with the academy / program vision.
25. It is difficult to determine who makes decisions about how to use resources for my academy / program.
26. My academy / program provides opportunities for me to improve my related skills, knowledge, or talents, if I want to participate.
27. Everyone (students and / or adults) in my academy / program is involved in lifelong learning to increase their related skills, knowledge, or talents.
28. My academy / program does not provide a support system for helping participants meet their responsibilities.
29. I believe I can learn more career-related knowledge associated with my academy / program outside the academy / program than by participating within it.
30. My academy / program is flexible enough to adapt to change in related industries or academic requirements.
31. I believe my academy / program gets better (with respect to the vision statement, goals, and objectives) every year.
32. I believe everyone involved with my academy / program (students and / or adults) plays a part in making my academy / program better (with respect to the vision statement, goals, and objectives).
33. I believe my academy / program is a successful organization.
34. My academy / program is recognized as successful by others through awards, public media (newspaper, online, or television reports of achievement), or other methods. (Please specify the 'other' method in the Comment box).
35. I would recommend my academy / program to students / colleagues who I know, who are interested in aviation / aerospace / engineering education and / or careers.

Demographic information will be requested in an additional page. Participants will be able to select responses for each item. For the items related to GPA, a grade of F is $0, \mathrm{D}$ is 1.00 , etc.

- Gender (male, female)
- Race or Ethnic Group (African American, White - Non-Hispanic, Native American or Inuit, Asian or Pacific Islander, Hispanic, Multiracial, Other - with comment box)
- Academy Population Subgroup (student, parent, career education teacher, core content teacher, administrator, school staff, advisory board member, alumni)
- [for students] Class (freshman, sophomore, junior, senior)
- [for students] Years in the Academy (less than 1, at least 1 but less than 2, at least 2 but less than 3, at least 3 but less than 4 , at least 4 )
- [for students] Estimated cumulative weighted scale GPA for all classes (less than 1.00 , at least 1.00 but less than 2.00 , at least 2.00 but less than 3.00 , at least 3.00 but less than 4.00, at least 4.00)
- [for students] Estimated cumulative weighted scale GPA for career or technical classes (less than 1.00, at least 1.00 but less than 2.00, at least 2.00 but less than 3.00, at least 3.00 but less than 4.00, at least 4.00)
- [for adults] Estimated Income Range (up to $\$ 30,000$; at least $\$ 30,000$ but less than $\$ 50,000$; at least $\$ 50,000$ but less than $\$ 75,000$; at least $\$ 75,000$ but less than $\$ 100,000$; at least $\$ 100,000$ but less than $\$ 200,000$; at least $\$ 200,000$ )
- [for non-career course teacher adults] Estimated number of hours devoted to academy students or programs per week (up to 2 , at least 2 but less than 5 , at least 5 but less than 10, at least 10)


## APPENDIX C

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Table C1
Motivational Theories

| Theory | Major Researcher(s) | Description |
| :---: | :---: | :---: |
| Theories Focused on Expectancy of Success |  |  |
| Self-Efficacy Theory | Bandura (1997) | Social-cognitive model Measures how confident individual is in ability to arrange, implement, and manage plan for solving a problem or completing task Efficacy expectation is driving force behind goal setting, activity selection, inclination to apply effort, and diligence |
| Locus of Control Theories | Connell (1985) <br> Wellborn (1991) <br> E. Skinner (1995) | Individual expectation of success based on extent of internal locus of control (successes and failures) Unknown control undermines motivation <br> 3 Basic Needs: competence, autonomy, relatedness - all influenced by sense of control <br> 3 Critical Beliefs: meansends, control, agency - all influence performance |
| Self-Determination Theory | Deci \& Ryan (1985) | Intrinsic motivation stressing innate, basic needs 2 Perspectives: humans motivated to maintain optimal level of stimulation; humans have basic needs for competence and personal causation (selfdetermination) External control with negative competence |

Table C1 (cont.)

Theories Focused on Reasons for Engagement
$\left.\left.\left.\begin{array}{lll}\hline & & \begin{array}{l}\text { feedback reduces intrinsic } \\ \text { motivation }\end{array} \\ \text { Flow Theory } & \text { Csikszentmihalyi (1988) } & \begin{array}{l}\text { Intrinsic motivation stressing } \\ \text { subjective experience }\end{array} \\ & \begin{array}{l}\text { Holistic feeling of being } \\ \text { immersed in, and carried by } \\ \text { activity } \\ \text { Merging of action and }\end{array} \\ \text { awareness }\end{array}\right\} \begin{array}{l}\text { Focus of attention on limited } \\ \text { stimulus field } \\ \text { Lack of self-consciousness }\end{array}\right\} \begin{array}{l}\text { Feeling in control of actions } \\ \text { and environment }\end{array}\right\}$

Table C1 (cont.)

Theories Focused on Reasons for Engagement

| Situational Interest | Hidi \& Baird (1986) | Focus on characteristics of academic tasks that create interest <br> Text comprehension and recall derived from personal relevance, novelty, activity level, and comprehensibility |
| :---: | :---: | :---: |
| Goal Theories | various | Focus on achievement behavior as it relates to achievement goals 2 kinds of goal patterns: egoinvolved goals and taskinvolved goals Ego-involved: individuals seek to maximize favorable evaluations and minimize negative evaluations (performance goals); individuals try to outperform others <br> Task-involved: individuals focus on mastering tasks and increasing competence (learning goals); individuals focus on improving own performance |

Theories Integrating Expectancy and Value Constructs

Attribution Theory $\quad$ Weiner (1985) | Individuals' interpretations of |
| :--- |
| achievement outcomes |
| determine subsequent |
| achievement efforts |
| Most important attributions: |
| ability, effort, task difficulty, |
| and luck |
| 3 causal dimensions: locus of |
| control, stability, and |
| controllability |

Table C1 (cont.)

| Theories Integrating Expectancy and Value Constructs |  |  |
| :---: | :---: | :---: |
| Modern ExpectancyValue Theory | various | Link achievement performance, persistence, and choice most directly to individuals' expectancyrelated and task-value beliefs Choices influenced by negative and positive task characteristics, have costs associated with them creating value |
| Self-Worth Theory | Covington (1992, 1998) | Tendency to establish and maintain positive self-image Key to maintaining sense of self-worth is protecting sense of academic competence Attributions for success: ability and effort Attribution for failure: not trying |

Theories Integrating Motivation and Cognition
Social Cognitive Theories various
Self-regulation related to metacognitive, motivational, and behavior activity level in individuals' learning processes
Context is important because some environments do not allow much latitude in choices 3 characteristics: use selfregulated strategies; believe in efficacious performance; set numerous and varied personal goals
3 processes: self-observation; self-judgment; self-reactions

Table C1 (cont.)

Theories Integrating Motivation and Cognition

| Motivation/Volition $\quad$ various | Strength of will needed to <br> complete a <br> task and diligence of pursuit <br> drive motivation to continue |
| :--- | :--- |
| working |  |
| Variety of control strategies |  |
| used: cognitive, emotional, |  |
| motivational, environmental |  |

Note. Adapted from information included in "Motivational beliefs, values, and goals," by J.S. Eccles \& A. Wigfield (2002), Annual Review of Psychology, 53, 109-132. Copyright 2002 by Annual Reviews.

Table C2
Contributing Researchers for Contigency Theory

| Source Configurations | Contingencies | Organizational Characteristics/ |
| :---: | :---: | :---: |
| Woodward $(1958,1965)$ | Technology (system of production) | Organizational structure, span of control, management hierarchies, degrees of job specialization |
| Burns \& Stalker (1961) | Environmental stability (rate of technological and market change) | Mechanistic organization / organic organization |
| Chandler, Jr. (1962) | Strategy (degree of diversification) | Divisional structure/functional structure |
| Lawrence \& Lorsch (1967) | Environmental uncertainty (rate of product innovation, changes in the market and/or process technology) | Integration of different mindsets/different organizational structures |
| Perrow (1967) | Technology (task characteristics: routine engineering, craft, Nonroutine), organizational structure (socializing institution, elite psychiatric agency, custodial institutions, programmed learning school) | Task structure (control and coordination); goal (system, product, derived) |
| Thompson (1967) plan, | Environmental <br> uncertainty, interdependencies between tasks/operations/resources | Coordination (coordination by <br> standardization, mutual adjustment) |

Table C2 (cont.)

| Mintzberg (1979) | Organizational <br> characteristics (age, size); <br> technology (regulation, | Simple structure; machine <br> bureaucracy, professional <br> bureaucracy, divisionalized |
| :--- | :--- | :--- |
|  | sophistication); environment <br> (complexity, hostility, stability, <br> form/structure, adhocracy |  |
|  | market diversity); power <br> (internal power, external control) |  |

Note. Adapted from "A bibliometric view on the use of contingency theory in projectmanagement research." By B. Hanish and A. Wald (2012, Jun). Project Management Journal, doi: 10.1002/pmj

Table C3
Goodness of Fit Indices

| Index | Possible Values | Description |
| :---: | :---: | :---: |
| CMIN | 0 and greater | minimum discrepancy between unrestricted sample covariance matrix and restricted matrix for saturated model; large values indicate rejection of null hypothesis; affected by sample size; $X^{2}$ statistic |
| CMIN/DF | 0 and greater | $X^{2}$ statistic divided by the model degrees of freedom; if value is smaller for hypothesized model than for independence model, indicates good fit |
| GFI | 0 to 1.00* | relative amount of variance and covariance of sample data explained jointly by hypothesized model; values closer to 1.00 indicate good fit |
| AGFI | 0 to 1.00* | GFI adjusted for degrees of freedom; values closer to 1.00 indicate good fit |
| NFI | 0 to 1.00 | comparison of hypothesized model and independence model; proportion in improvement of overall fit; affected by sample size; cutoff for good fit is . 95 ; marginal fit is .90 |
| CFI | 0 to 1.00 | NFI adjusted for sample size; cutoff for good fit is .95 |
| CAIC | 0 and greater | assessment of model fit, given parsimony; reflects extent to which parameter estimates from original sample will cross-validate in future samples; smaller values indicate better fit |

Table C3 (cont.)

| ECVI 0 and greater | likelihood that model cross-validates across <br> similar-sized samples from same population; <br> measures discrepancy between fitted <br> covariance matrix and expected covariance <br> matrix for another sample of same size; <br> smallest rank order value has greatest <br> potential for replication |
| :--- | :--- |
| Hoetler's CN | 0 and greater |
|  | estimates sample size sufficient to yield <br> adequate model fit for $X^{2}$ test; value greater <br> than 200 indicates adequate model |

Note. * GFI and AGFI may produce negative values and values greater than 1.00 for certain types of models. Adapted from information in B.M. Byrne (2010). Structural equation modeling with AMOS, (2 ${ }^{\text {nd }}$ ed.) New York: Routledge. Copyright by Routledge; and from R.B. Kline (1998). Principles and practice of structural equation modeling. New York: The Guilford Press. Copyright by The Guilford Press.

Table C4
Demographic Frequencies

|  |  | Frequency | Percent | Cumulative <br> Percent |
| :---: | :---: | :---: | :---: | :---: |
| Gender | Male | 208 | 59.6 | 59.6 |
|  | Female | 141 | 40.4 | 100.0 |
|  | Total | 349 | 100.0 |  |
| Race | White/Caucasian | 268 | 76.8 | 76.8 |
|  | Black/African | 36 | 10.3 | 87.1 |
|  | American |  |  |  |
|  | Hispanic | 18 | 5.2 | 92.3 |
|  | Asian/Pacific | 12 | 3.4 | 95.7 |
|  | Islander |  |  |  |
|  | American Indian or | 3 | 0.9 | 96.6 |
|  | Multiple | 12 | 3.4 | 100.0 |
|  | Ethnicities/Other |  |  |  |
|  | Total | 349 | 100.0 |  |
| Role | Student | 111 | 31.8 | 31.8 |
|  | CTE teacher | 102 | 29.2 | 61.0 |
|  | Alumnus / alumna |  |  |  |
|  |  | 25 | 7.2 | 68.2 |
|  | Core content teacher | 9 | 2.6 | 70.8 |
|  | Administrator | 51 | 14.6 | 85.4 |
|  | School staff | 7 | 2.0 | 87.4 |
|  | Parent / guardian | 14 | 4.0 | 91.4 |
|  | Advisory board member | 13 | 3.7 | 95.1 |
|  | Industry member / program mentor | 15 | 4.3 | 99.4 |
|  | Other (unspecified) |  |  |  |
|  |  | 2 | 0.6 | 100.0 |
|  | Total | 349 | 100.0 |  |

Table C4 (cont.).
Demographic Frequencies

|  |  | Frequency | Percent | Cumulative Percent |
| :---: | :---: | :---: | :---: | :---: |
| Student Grade |  |  |  |  |
| Level | Freshman | 12 | 11.7 | 11.7 |
|  | Sophomore | 21 | 20.4 | 32.0 |
|  | Junior | 46 | 44.7 | 76.7 |
|  | Senior | 24 | 23.3 | 100.0 |
|  | Total | 103 | 100.0 |  |
| Student \# |  |  |  |  |
| Years in |  |  |  |  |
| Program | $<1$ year | 38 | 35.8 | 35.8 |
|  | $>1$ year but |  |  |  |
|  | $<2$ years | 13 | 12.3 | 48.1 |
|  | $>2$ years but |  |  |  |
|  | $<3$ years | 10 | 9.4 | 57.5 |
|  | $>3$ years but |  |  |  |
|  | $<4$ years | 33 | 31.1 | 88.7 |
|  | $>4$ years | 12 | 11.3 | 100.0 |
|  | Total | 106 | 100.0 |  |
| Student |  |  |  |  |
| Estimated |  |  |  |  |
| Cumulative | $>2.00$ but |  |  |  |
| GPA | <3.00 | 15 | 14.3 | 14.3 |
|  | > 3.00 but |  |  |  |
|  | < 4.00 | 65 | 61.9 | 76.2 |
|  | > 4.00 | 25 | 23.8 | 100.0 |
|  | Total | 105 | 100.0 |  |
| Student |  |  |  |  |
| Estimated CTE | $>2.00$ but |  |  |  |
| GPA | < 3.00 | 6 | 5.8 | 5.8 |
|  | > 3.00 but |  |  |  |
|  | < 4.00 | 65 | 62.5 | 68.3 |
|  | > 4.00 | 33 | 31.7 | 100.0 |
|  | Total | 104 | 100.0 |  |

Table C4 (cont.)

|  | Frequency | Percent | Cumulative <br> Percent |  |
| :--- | :--- | ---: | :--- | ---: |
| Adult |  |  |  |  |
| Estimated |  |  |  |  |
| Household |  | 6 | 3.0 | 3.0 |
| Income (in \$) | $<25 \mathrm{~K}$ | 30 | 15.2 | 18.2 |
|  | $50 \mathrm{~K}-74,999$ | 45 | 22.7 | 40.9 |
|  | $75 \mathrm{~K}-99,999$ | 45 | 22.7 | 63.6 |
|  | $100 \mathrm{~K}-124,999$ | 25 | 12.6 | 76.3 |
|  | $125 \mathrm{~K}-149,999$ | 25 | 12.6 | 88.9 |
|  | $150 \mathrm{~K}-174,999$ | 1 | 0.5 | 89.4 |
|  | $175 \mathrm{~K}-199,999$ | 21 | 10.6 | 100.0 |
|  | $\geq 200 \mathrm{~K}$ | 198 | 100.0 |  |
|  | Total |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Adult |  |  |  |  |
| Participation |  | 47 | 16.6 | 16.6 |
| Level (in hours |  | 21.1 | 37.7 |  |
| per week) | $<2$ | 32 | 14.3 | 52.0 |
|  | $\geq 2$ but $<5$ | 58 | 26.0 | 78.0 |
|  | $\geq 5$ but $<10$ | 49 | 22.0 | 100.0 |
|  | $\geq 10$ | 223 | 100.0 |  |
|  | CTE teacher |  |  |  |

Table C5
Chi-squared Test of Independence Results for Demographic Characteristics

| Variables | $X^{2}$ | $d f$ | $p$-value | \% Expected cells $<5$ | Usable |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Gender \& Race | 3.294 | 5 | 0.655 | 33.3\% | No |
| Gender \& Role | 29.790 | 9 | $<0.001$ | 25\% | No |
| Gender \& Student Grade Level | 0.363 | 3 | 0.948 | 12.5\% | Yes |
| Gender \& Student Yrs in Program | 7.174 | 4 | 0.127 | 30\% | No |
|  <br> Student Est <br> HS GPA | 4.939 | 2 | 0.085 | 0\% | Yes |
|  <br> Student Est <br> CTE GPA | 0.991 | 2 | 0.609 | 33.3\% | No |
| Gender \& Household Income | 10.933 | 7 | 0.142 | 25\% | No |
|  <br> Adult Est <br> Program Hrs | 6.314 | 4 | 0.177 | 0\% | Yes |
| Race \& Role | 69.178 | 45 | 0.012 | 76.7\% | No |
|  <br> Student Grade Level | 22.660 | 15 | 0.092 | 75\% | No |
| Race \& Student Yrs in Program | 35.606 | 20 | 0.017 | 76.7\% | No |

Race \&

Student Es HS GPA Race \& Student Est CTE GPA

Race \&
Household
Income

Race \&
Adult Est
Program Hrs
Role \&
Household 73.252
Income
Role \&
Adult Est
Program Hrs
Student Gr
Level \& Yrs
in Program
Student Gr
Level \& Est
6.323 HS GPA

Student Gr
Level \& Est
CTE GPA
Student Yrs
in Program
\& Est HS
GPA

Student Yrs in Program
2.706
\& CTE GPA
Progran
4.996
7.861

56
0.061
84.7\%

No

8
0.447
46.7\%

No

8 0.951 53.3\%

No

| Student Est <br>  <br> CTE GPA | 61.426 | 4 | $<0.001$ | $44.4 \%$ | No |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Household <br>  <br> Adult Est <br> Hrs | 32.072 | 28 | 0.272 | $47.5 \%$ | No |

Table C6
Frequencies for Participant Responses

| Survey Item | Response | Frequency | Percent | Cumulative Percent |
| :---: | :---: | :---: | :---: | :---: |
| Q1 | Strongly disagree | 2 | 0.6 | 0.6 |
|  | Disagree | 4 | 1.1 | 1.7 |
|  | No opinion | 13 | 3.7 | 5.4 |
|  | Agree | 167 | 47.7 | 53.1 |
|  | Strongly agree | 164 | 46.9 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q2 | Strongly disagree | 0 | 0.0 | 0.0 |
|  | Disagree | 10 | 2.9 | 2.9 |
|  | No opinion | 26 | 7.4 | 10.3 |
|  | Agree | 166 | 47.4 | 57.7 |
|  | Strongly agree | 148 | 42.3 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q3 | Strongly disagree | 0 | 0.0 | 0.0 |
|  | Disagree | 1 | 0.3 | 0.3 |
|  | No opinion | 12 | 3.4 | 3.7 |
|  | Agree | 128 | 36.6 | 40.3 |
|  | Strongly agree | 209 | 59.7 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q4 | Strongly disagree | 2 | 0.6 | 0.6 |
|  | Disagree | 16 | 4.6 | 5.1 |
|  | No opinion | 49 | 14.0 | 19.1 |
|  | Agree | 186 | 53.1 | 72.3 |
|  | Strongly agree | 97 | 27.7 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q5R | Strongly agree | 16 | 4.6 | 4.6 |
|  | Agree | 49 | 14.0 | 18.6 |
|  | No opinion | 64 | 18.3 | 36.9 |
|  | Disagree | 169 | 48.3 | 85.1 |
|  | Strongly disagree | 52 | 14.9 | 100.0 |
|  | Total | 350 | 100.0 |  |

Table C6 (cont.)

| Survey Item | Response | Frequency | Percent | Cumulative Percent |
| :---: | :---: | :---: | :---: | :---: |
| Q6 | Strongly disagree | 4 | 1.1 | 1.1 |
|  | Disagree | 51 | 14.6 | 15.7 |
|  | No opinion | 62 | 17.7 | 33.4 |
|  | Agree | 167 | 47.7 | 81.1 |
|  | Strongly agree | 66 | 18.9 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q7 | Strongly disagree | 0 | 0.0 | 0.0 |
|  | Disagree | 5 | 1.4 | 1.4 |
|  | No opinion | 42 | 12.0 | 13.4 |
|  | Agree | 185 | 52.9 | 66.3 |
|  | Strongly agree | 118 | 33.7 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q8 | Strongly disagree | 0 | 0.0 | 0.0 |
|  | Disagree | 21 | 6.0 | 6.0 |
|  | No opinion | 22 | 6.3 | 12.3 |
|  | Agree | 186 | 53.1 | 65.4 |
|  | Strongly agree | 121 | 34.6 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q9 | Strongly disagree | 5 | 1.4 | 1.4 |
|  | Disagree | 43 | 12.3 | 13.7 |
|  | No opinion | 51 | 14.6 | 28.3 |
|  | Agree | 180 | 51.4 | 79.7 |
|  | Strongly agree | 71 | 20.3 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q10 | Strongly disagree | 2 | 0.6 | 0.6 |
|  | Disagree | 14 | 4.0 | 4.6 |
|  | No opinion | 18 | 5.1 | 9.7 |
|  | Agree | 152 | 43.4 | 53.1 |
|  | Strongly agree | 164 | 46.9 | 100.0 |
|  | Total | 350 | 100.0 |  |

Table C6 (cont.)

| Survey Item | Response | Frequency | Percent | Cumulative Percent |
| :---: | :---: | :---: | :---: | :---: |
| Q11 | Strongly disagree | 6 | 1.7 | 1.7 |
|  | Disagree | 66 | 18.9 | 20.6 |
|  | No opinion | 66 | 18.9 | 39.4 |
|  | Agree | 161 | 46.0 | 85.4 |
|  | Strongly agree | 51 | 14.6 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q12 | Strongly disagree | 3 | 0.9 | 0.9 |
|  | Disagree | 24 | 6.9 | 7.7 |
|  | No opinion | 42 | 12.0 | 19.7 |
|  | Agree | 181 | 51.7 | 71.4 |
|  | Strongly agree | 100 | 28.6 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q13 | Strongly disagree | 4 | 1.1 | 1.1 |
|  | Disagree | 42 | 12.0 | 13.1 |
|  | No opinion | 43 | 12.3 | 25.4 |
|  | Agree | 176 | 50.3 | 75.7 |
|  | Strongly agree | 85 | 24.3 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q14 | Strongly disagree | 3 | 0.9 | 0.9 |
|  | Disagree | 40 | 11.4 | 12.3 |
|  | No opinion | 35 | 10.0 | 22.3 |
|  | Agree | 183 | 52.3 | 74.6 |
|  | Strongly agree | 89 | 25.4 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q15R | Strongly agree | 54 | 15.4 | 15.4 |
|  | Agree | 121 | 34.6 | 50.0 |
|  | No opinion | 83 | 23.7 | 73.7 |
|  | Disagree | 80 | 22.9 | 96.6 |
|  | Strongly disagree | 12 | 3.4 | 100.0 |
|  | Total | 350 | 100.0 |  |

Table C6 (cont.)

| Survey Item | Response | Frequency | Percent | Cumulative Percent |
| :---: | :---: | :---: | :---: | :---: |
| Q16R | Strongly agree | 12 | 3.4 | 3.4 |
|  | Agree | 53 | 15.1 | 18.6 |
|  | No opinion | 52 | 14.9 | 33.4 |
|  | Disagree | 179 | 51.1 | 84.6 |
|  | Strongly disagree | 54 | 15.4 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q17 | Strongly disagree | 1 | 0.3 | 0.3 |
|  | Disagree | 17 | 4.9 | 5.1 |
|  | No opinion | 16 | 4.6 | 9.7 |
|  | Agree | 153 | 43.7 | 53.4 |
|  | Strongly agree | 163 | 46.6 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q18 | Strongly disagree | 1 | 0.3 | 0.3 |
|  | Disagree | 16 | 4.6 | 4.9 |
|  | No opinion | 21 | 6.0 | 10.9 |
|  | Agree | 163 | 46.6 | 57.4 |
|  | Strongly agree | 149 | 42.6 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q19 | Strongly disagree | 4 | 1.1 | 1.1 |
|  | Disagree | 46 | 13.1 | 14.3 |
|  | No opinion | 36 | 10.3 | 24.6 |
|  | Agree | 190 | 54.3 | 78.9 |
|  | Strongly agree | 74 | 21.1 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q20R | Strongly agree | 37 | 10.6 | 10.6 |
|  | Agree | 81 | 23.1 | 33.7 |
|  | No opinion | 77 | 22.0 | 55.7 |
|  | Disagree | 121 | 34.6 | 90.3 |
|  | Strongly disagree | 34 | 9.7 | 100.0 |
|  | Total | 350 | 100.0 |  |

Table C6 (cont.)

| Survey Item | Response | Frequency | Percent | Cumulative Percent |
| :---: | :---: | :---: | :---: | :---: |
| Q21 | Strongly disagree | 4 | 1.1 | 1.1 |
|  | Disagree | 50 | 14.3 | 15.4 |
|  | No opinion | 29 | 8.3 | 23.7 |
|  | Agree | 172 | 49.1 | 72.9 |
|  | Strongly agree | 95 | 27.1 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q22 | Strongly disagree | 7 | 2.0 | 2.0 |
|  | Disagree | 51 | 14.6 | 16.6 |
|  | No opinion | 28 | 8.0 | 24.6 |
|  | Agree | 181 | 51.7 | 76.3 |
|  | Strongly agree | 83 | 23.7 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q23 | Strongly disagree | 7 | 2.0 | 2.0 |
|  | Disagree | 62 | 17.7 | 19.7 |
|  | No opinion | 31 | 8.9 | 18.6 |
|  | Agree | 185 | 52.9 | 81.4 |
|  | Strongly agree | 65 | 18.6 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q24R | Strongly agree | 16 | 4.6 | 4.6 |
|  | Agree | 92 | 26.3 | 30.9 |
|  | No opinion | 81 | 23.1 | 54.0 |
|  | Disagree | 126 | 36.0 | 90.0 |
|  | Strongly disagree | 35 | 10.0 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q25R | Strongly agree | 10 | 2.9 | 2.9 |
|  | Agree | 67 | 19.1 | 22.0 |
|  | No opinion | 51 | 14.6 | 36.6 |
|  | Disagree | 175 | 50.0 | 86.6 |
|  | Strongly disagree | 47 | 13.4 | 100.0 |
|  | Total | 350 | 100.0 |  |

Table C6 (cont.)

| Survey Item | Response | Frequency | Percent | Cumulative Percent |
| :---: | :---: | :---: | :---: | :---: |
| Q26 | Strongly disagree | 1 | 0.3 | 0.3 |
|  | Disagree | 9 | 2.6 | 2.9 |
|  | No opinion | 19 | 5.4 | 8.3 |
|  | Agree | 186 | 53.1 | 61.4 |
|  | Strongly agree | 135 | 38.6 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q27 | Strongly disagree | 4 | 1.1 | 1.1 |
|  | Disagree | 36 | 10.3 | 11.4 |
|  | No opinion | 41 | 11.7 | 23.1 |
|  | Agree | 175 | 50.0 | 73.1 |
|  | Strongly agree | 94 | 26.9 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q28R | Strongly agree | 12 | 3.4 | 3.4 |
|  | Agree | 44 | 12.6 | 16.0 |
|  | No opinion | 58 | 16.6 | 32.6 |
|  | Disagree | 181 | 51.7 | 84.3 |
|  | Strongly disagree | 55 | 15.7 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q29R | Strongly agree | 47 | 13.4 | 13.4 |
|  | Agree | 66 | 18.9 | 32.3 |
|  | No opinion | 42 | 12.0 | 44.3 |
|  | Disagree | 154 | 44.0 | 88.3 |
|  | Strongly disagree | 41 | 11.7 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q30 | Strongly disagree | 4 | 1.1 | 1.1 |
|  | Disagree | 25 | 7.1 | 8.3 |
|  | No opinion | 39 | 11.1 | 19.4 |
|  | Agree | 186 | 53.1 | 72.6 |
|  | Strongly agree | 96 | 27.4 | 100.0 |
|  | Total | 350 | 100.0 |  |

Table C6 (cont.)

| Survey Item | Response | Frequency | Percent | Cumulative Percent |
| :---: | :---: | :---: | :---: | :---: |
| Q31 | Strongly disagree | 2 | 0.6 | 0.6 |
|  | Disagree | 14 | 4.0 | 4.6 |
|  | No opinion | 50 | 14.3 | 18.9 |
|  | Agree | 169 | 48.3 | 67.1 |
|  | Strongly agree | 115 | 32.9 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q32 | Strongly disagree | 3 | 0.9 | 0.9 |
|  | Disagree | 22 | 6.3 | 7.1 |
|  | No opinion | 26 | 7.4 | 14.6 |
|  | Agree | 200 | 57.1 | 71.7 |
|  | Strongly agree | 99 | 28.3 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q33 | Strongly disagree | 2 | 0.6 | 0.6 |
|  | Disagree | 8 | 2.3 | 2.9 |
|  | No opinion | 20 | 5.7 | 8.6 |
|  | Agree | 175 | 50.0 | 58.6 |
|  | Strongly agree | 145 | 41.4 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q34 | Strongly disagree | 7 | 2.0 | 2.0 |
|  | Disagree | 22 | 6.3 | 8.3 |
|  | No opinion | 49 | 14.0 | 22.3 |
|  | Agree | 158 | 45.1 | 67.4 |
|  | Strongly agree | 114 | 32.6 | 100.0 |
|  | Total | 350 | 100.0 |  |
| Q35 | Strongly disagree | 2 | 0.6 | 0.6 |
|  | Disagree | 8 | 2.3 | 2.9 |
|  | No opinion | 17 | 4.9 | 7.7 |
|  | Agree | 124 | 35.4 | 43.1 |
|  | Strongly agree | 199 | 56.9 | 100.0 |
|  | Total | 350 | 100.0 |  |

Table C7
Most Frequent Words and Phrases

| Survey Item | Word / Phrase | Frequency | Percent |
| :---: | :---: | :---: | :---: |
| Q3 | Skill | 4 | 18.18 |
|  | High school | 3 | 13.64 |
|  | Aviation | 3 | 13.64 |
|  | Teaches | 3 | 13.64 |
|  | Allow | 3 | 13.64 |
|  | Well | 3 | 13.64 |
|  | Learning | 3 | 13.64 |
|  | Flight | 3 | 13.64 |
|  | Help | 3 | 13.64 |
|  | Years | 3 | 13.64 |
| Q9 | Work | 4 | 19.05 |
|  | Making | 3 | 14.29 |
|  | Sometimes | 3 | 14.29 |
| Q10 | Work | 5 | 18.52 |
|  | Students | 5 | 18.52 |
|  | Always | 4 | 14.81 |
|  | Participate | 3 | 11.11 |
|  | Volunteer | 3 | 11.11 |
|  | Yes | 3 | 11.11 |
|  | Level | 3 | 11.11 |
|  | Part | 3 | 11.11 |
|  | End | 3 | 11.11 |
|  | Members | 3 | 11.11 |
| Q12 | One | 4 | 11.43 |
|  | Knows | 4 | 11.43 |
|  | Level | 4 | 11.43 |
|  | Teachers | 4 | 11.43 |
|  | National | 3 | 8.57 |
|  | Students | 3 | 8.57 |
| Q14 | Teachers / Professors | 5 | 20.83 |
|  | Support | 3 | 12.50 |
|  | Take | 3 | 12.50 |
|  | System | 3 | 12.50 |

Table C7 (cont.)

| Survey Item | Word / Phrase | Frequency | Percent |
| :---: | :---: | :---: | :---: |
| Q15R | Will | 3 | 12 |
|  | Year | 3 | 12 |
|  | However | 3 | 12 |
|  | Available | 3 | 12 |
| Q18 | See | 4 | 12.50 |
|  | Help | 4 | 12.50 |
|  | Everyone | 4 | 12.50 |
|  | Little | 3 | 9.38 |
| Q20R | Sometimes | 5 | 18.52 |
|  | Organization | 4 | 14.81 |
|  | Within | 3 | 11.11 |
|  | Lose | 3 | 11.11 |
|  | Yes | 3 | 11.11 |
|  | Everyone | 3 | 11.11 |
|  | One | 3 | 11.11 |
|  | School | 3 | 11.11 |
| Q21 | School | 5 | 11.11 |
|  | Better | 5 | 11.11 |
|  | Funding | 5 | 11.11 |
|  | Year | 4 | 8.89 |
|  | Students | 3 | 6.67 |
| Q22 | Resources | 10 | 25 |
|  | Use | 4 | 10 |
|  | Available | 4 | 10 |
|  | Computers | 3 | 7.5 |
|  | Always | 3 | 7.5 |
|  | Old | 3 | 7.5 |
|  | Access | 3 | 7.5 |
|  | Better | 3 | 7.5 |
| Q23 | Always / Always use | 8 | 25 |
|  | Sometimes | 3 | 9.38 |
|  | Working | 3 | 9.38 |
|  | Time | 3 | 9.38 |
|  | Students | 3 | 9.38 |

Table C7 (cont.)

| Survey Item | Word / Phrase | Frequency | Percentage |
| :---: | :---: | :---: | :---: |
| Q31 | Learning | 4 | 11.11 |
|  | Go | 4 | 11.11 |
|  | Vary | 3 | 8.33 |
|  | Volunteer | 3 | 8.33 |
|  | Keeping | 3 | 8.33 |
|  | Classes | 3 | 8.33 |
|  | Training | 3 | 8.33 |
|  | Constantly | 3 | 8.33 |
|  | Change | 3 | 8.33 |
|  | Make | 3 | 8.33 |
|  | Ways | 3 | 8.33 |
|  | Progress | 3 | 8.33 |
|  | New | 3 | 8.33 |
|  | Students | 3 | 8.33 |
| Q34 | Students | 5 | 13.16 |
|  | School | 4 | 10.53 |
|  | State | 4 | 10.5 |
|  | Team | 3 | 7.89 |
|  | National | 3 | 7.89 |
|  | Board | 3 | 7.89 |
|  | Social media | 3 | 7.89 |
|  | Level | 3 | 7.89 |
|  | Work | 3 | 7.89 |
|  | College | 3 | 7.89 |
|  | Community | 3 | 7.89 |
|  | Better | 3 | 7.89 |
|  | Job | 3 | 7.89 |
|  | Local | 3 | 7.89 |
|  | Air Force | 3 | 7.89 |

Table C8
Inter-item Correlation Matrix

|  | Q 1 | Q 2 | Q 3 | Q 4 | Q 5 R | Q 6 | Q 7 | Q 8 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Q1 | 1.000 |  |  |  |  |  |  |  |
| Q2 | 0.453 | 1.000 |  |  |  |  |  |  |
| Q3 | 0.411 | 0.404 | 1.000 |  |  |  |  |  |
| Q4 | 0.412 | 0.493 | 0.328 | 1.000 |  |  |  |  |
| Q5R | 0.174 | 0.259 | 0.170 | 0.326 | 1.000 |  |  |  |
| Q6 | 0.275 | 0.295 | 0.169 | 0.421 | 0.040 | 1.000 |  |  |
| Q7 | 0.420 | 0.511 | 0.367 | 0.641 | 0.263 | 0.375 | 1.000 |  |
| Q8 | 0.366 | 0.401 | 0.353 | 0.496 | 0.158 | 0.363 | 0.452 | 1.000 |
|  |  |  |  |  |  |  |  |  |
|  | Q1 | Q2 | Q3 | Q4 | Q5R | Q6 | Q7 | Q8 |
| Q9 | 0.244 | 0.249 | 0.218 | 0.390 | 0.095 | 0.375 | 0.312 | 0.497 |
| Q10 | 0.361 | 0.334 | 0.347 | 0.383 | 0.126 | 0.281 | 0.312 | 0.392 |
| Q11 | 0.209 | 0.297 | 0.235 | 0.265 | 0.015 | 0.313 | 0.164 | 0.408 |
| Q12 | 0.311 | 0.361 | 0.367 | 0.456 | 0.152 | 0.371 | 0.317 | 0.441 |
| Q13 | 0.275 | 0.355 | 0.304 | 0.415 | 0.126 | 0.353 | 0.396 | 0.489 |
| Q14 | 0.367 | 0.392 | 0.341 | 0.378 | 0.152 | 0.312 | 0.368 | 0.420 |
| Q15R | -0.051 | -0.016 | -0.051 | -0.018 | 0.240 | -0.057 | -0.028 | -0.121 |
| Q16R | 0.227 | 0.210 | 0.183 | 0.231 | 0.522 | 0.077 | 0.223 | 0.172 |
|  |  |  |  |  |  |  |  |  |
|  | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15R | Q16R |
| Q9 | 1.000 |  |  |  |  |  |  |  |
| Q10 | 0.312 | 1.000 |  |  |  |  |  |  |
| Q11 | 0.378 | 0.345 | 1.000 |  |  |  |  |  |
| Q12 | 0.368 | 0.351 | 0.304 | 1.000 |  |  |  |  |
| Q13 | 0.384 | 0.316 | 0.340 | 0.369 | 1.000 |  |  |  |
| Q14 | 0.328 | 0.358 | 0.373 | 0.382 | 0.484 | 1.000 |  |  |
| Q15R | -0.152 | 0.003 | -0.098 | -0.107 | -0.036 | -0.018 | 1.000 |  |
| Q16R | 0.089 | 0.157 | 0.033 | 0.190 | 0.180 | 0.264 | 0.157 | 1.000 |
|  |  |  |  |  |  |  |  |  |
|  | Q1 | Q2 | Q3 | Q4 | Q5R | Q6 | Q7 | Q8 |
| Q17 | 0.407 | 0.346 | 0.341 | 0.543 | 0.252 | 0.381 | 0.380 | 0.574 |
| Q18 | 0.408 | 0.264 | 0.359 | 0.423 | 0.141 | 0.386 | 0.295 | 0.417 |
| Q19 | 0.344 | 0.315 | 0.316 | 0.383 | 0.032 | 0.400 | 0.344 | 0.391 |
| Q20R | 0.090 | 0.108 | 0.080 | 0.169 | 0.470 | -0.056 | 0.143 | 0.162 |
| Q21 | 0.292 | 0.311 | 0.328 | 0.389 | 0.066 | 0.284 | 0.257 | 0.319 |
| Q22 | 0.257 | 0.265 | 0.296 | 0.375 | 0.041 | 0.271 | 0.250 | 0.270 |
| Q23 | 0.246 | 0.246 | 0.293 | 0.324 | 0.002 | 0.296 | 0.308 | 0.383 |
| Q24R | 0.141 | 0.256 | 0.202 | 0.282 | 0.486 | 0.110 | 0.258 | 0.155 |
|  |  |  |  |  |  |  |  |  |


|  | Q 9 | Q 10 | Q 11 | Q 12 | Q 13 | Q 14 | Q 15 R | Q 16 R |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Q17 | 0.419 | 0.425 | 0.341 | 0.312 | 0.400 | 0.341 | -0.045 | 0.199 |
| Q18 | 0.376 | 0.343 | 0.304 | 0.460 | 0.336 | 0.364 | -0.072 | 0.205 |
| Q19 | 0.466 | 0.382 | 0.386 | 0.321 | 0.417 | 0.408 | -0.051 | 0.095 |
| Q20R | -0.031 | -.114 | 0.096 | 0.028 | 0.089 | 0.128 | 0.238 | 0.399 |
| Q21 | 0.206 | 0.332 | 0.285 | 0.454 | 0.372 | 0.335 | -0.027 | 0.098 |
| Q22 | 0.147 | 0.338 | 0.293 | 0.396 | 0.325 | 0.413 | -0.024 | 0.078 |
| Q23 | 0.328 | 0.222 | 0.304 | 0.281 | 0.377 | 0.343 | -0.060 | 0.058 |
| Q24R | 0.041 | 0.103 | 0.115 | 0.063 | 0.210 | 0.210 | 0.314 | 0.347 |
|  |  |  |  |  |  |  |  |  |
|  | Q17 | Q18 | Q19 | Q20R | Q21 | Q22 | Q23 | Q24R |
| Q17 | 1.000 |  |  |  |  |  |  |  |
| Q18 | 0.499 | 1.000 |  |  |  |  |  |  |
| Q19 | 0.372 | 0.382 | 1.000 |  |  |  |  |  |
| Q20R | 0.102 | 0.052 | 0.070 | 1.000 |  |  |  |  |
| Q21 | 0.302 | 0.361 | 0.305 | 0.045 | 1.000 |  |  |  |
| Q22 | 0.329 | 0.387 | 0.312 | 0.042 | 0.685 | 1.000 |  |  |
| Q23 | 0.331 | 0.318 | 0.288 | 0.037 | 0.393 | 0.346 | 1.000 |  |
| Q24R | 0.188 | 0.147 | 0.152 | 0.465 | 0.125 | 0.088 | 0.156 | 1.000 |
|  |  |  |  |  |  |  |  |  |
|  | Q1 | Q2 | Q3 | Q4 | Q5R | Q6 | Q7 | Q8 |
| Q25R | 0.242 | 0.319 | 0.233 | 0.331 | 0.569 | 0.133 | 0.318 | 0.267 |
| Q26 | 0.326 | 0.388 | 0.332 | 0.359 | 0.143 | 0.274 | 0.347 | 0.389 |
| Q27 | 0.240 | 0.254 | 0.232 | 0.356 | 0.063 | 0.267 | 0.275 | 0.472 |
| Q28R | 0.216 | 0.338 | 0.241 | 0.275 | 0.514 | 0.170 | 0.222 | 0.201 |
| Q29R | 0.146 | 0.175 | 0.101 | 0.064 | 0.474 | 0.007 | 0.114 | 0.022 |
| Q30 | 0.455 | 0.382 | 0.337 | 0.427 | 0.123 | 0.281 | 0.338 | 0.370 |
| Q31 | 0.404 | 0.297 | 0.421 | 0.427 | 0.129 | 0.320 | 0.358 | 0.441 |
| Q32 | 0.341 | 0.306 | 0.227 | 0.366 | 0.109 | 0.313 | 0.371 | 0.499 |
|  |  |  |  |  |  |  |  |  |
|  | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15R | Q16R |
| Q25R | 0.168 | 0.250 | 0.117 | 0.189 | 0.210 | 0.233 | 0.214 | 0.491 |
| Q26 | 0.386 | 0.254 | 0.204 | 0.293 | 0.332 | 0.370 | -0.045 | 0.107 |
| Q27 | 0.338 | 0.396 | 0.393 | 0.275 | 0.356 | 0.332 | -0.050 | -.040 |
| Q28R | 0.133 | 0.189 | 0.105 | 0.172 | 0.203 | 0.150 | 0.174 | 0.508 |
| Q29R | -0.079 | 0.073 | -0.077 | 0.036 | 0.004 | 0.050 | 0.244 | 0.358 |
| Q30 | 0.397 | 0.318 | 0.365 | 0.347 | 0.379 | 0.393 | -0.023 | 0.085 |
| Q31 | 0.408 | 0.386 | 0.312 | 0.435 | 0.393 | 0.368 | -0.085 | 0.177 |
| Q32 | 0.487 | 0.325 | 0.337 | 0.429 | 0.414 | 0.351 | -0.151 | 0.114 |
|  |  |  |  |  |  |  |  |  |


|  | Q17 | Q18 | Q19 | Q20R | Q21 | Q22 | Q23 | Q24R |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Q25R | 0.277 | 0.240 | 0.207 | 0.402 | 0.120 | 0.093 | 0.034 | 0.449 |
| Q26 | 0.373 | 0.276 | 0.273 | 0.034 | 0.196 | 0.213 | 0.170 | 0.164 |
| Q27 | 0.414 | 0.273 | 0.369 | 0.095 | 0.261 | 0.284 | 0.226 | 0.091 |
| Q28R | 0.269 | 0.162 | 0.108 | 0.305 | 0.231 | 0.197 | 0.113 | 0.344 |
| Q29R | 0.052 | 0.017 | -0.059 | 0.376 | -0.032 | -0.049 | -0.101 | 0.331 |
| Q30 | 0.394 | 0.293 | 0.423 | -0.007 | 0.337 | 0.363 | 0.310 | 0.108 |
| Q31 | 0.355 | 0.351 | 0.354 | 0.095 | 0.381 | 0.307 | 0.347 | 0.118 |
| Q32 | 0.373 | 0.375 | 0.449 | 0.130 | 0.253 | 0.216 | 0.296 | 0.138 |
|  |  |  |  |  |  |  |  |  |
|  | Q25R | Q26 | Q27 | Q28R | Q29R | Q30 | Q31 | Q32 |
| Q25R | 1.000 |  |  |  |  |  |  |  |
| Q26 | 0.144 | 1.000 |  |  |  |  |  |  |
| Q27 | 0.211 | 0.191 | 1.000 |  |  |  |  |  |
| Q28R | 0.518 | 0.197 | 0.045 | 1.000 |  |  |  |  |
| Q29R | 0.411 | 0.059 | -0.075 | 0.318 | 1.000 |  |  |  |
| Q30 | 0.234 | 0.292 | 0.325 | 0.150 | 0.029 | 1.000 |  |  |
| Q31 | 0.221 | 0.354 | 0.323 | 0.102 | -0.008 | 0.361 | 1.000 |  |
| Q32 | 0.152 | 0.273 | 0.493 | 0.070 | 0.062 | 0.272 | 0.342 | 1.000 |

Note. Cells in which the correlation $>0.30$ were highlighted; the diagonal values (1.000) were not highlighted because the diagonal is comprised of cells where the row variable and the column variable are the same.

Table C9
Anti-image Correlation Matrix

|  | Q1 | Q2 | Q3 | Q4 | Q5R | Q6 | Q7 | Q8 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Q1 | 0.919 |  |  |  |  |  |  |  |
| Q2 | -0.161 | 0.940 |  |  |  |  |  |  |
| Q3 | -0.091 | -0.100 | 0.925 |  |  |  |  |  |
| Q4 | -0.005 | -0.123 | 0.109 | 0.930 |  |  |  |  |
| Q5R | 0.039 | -0.016 | 0.006 | -0.133 | 0.888 |  |  |  |
| Q6 | -0.004 | 0.004 | 0.167 | -0.080 | 0.091 | 0.927 |  |  |
| Q7 | -0.092 | -0.181 | -0.125 | -0.394 | -0.032 | -0.141 | 0.912 |  |
| Q8 | 0.004 | -0.046 | -0.020 | -0.015 | 0.071 | 0.012 | -0.103 | 0.952 |
|  | Q1 | Q2 | Q3 | Q4 | Q5R | Q6 | Q7 | Q8 |
| Q9 | 0.134 | 0.084 | 0.082 | -0.051 | 0.071 | 0.012 | 0.012 | -0.121 |
| Q10 | -0.073 | -0.037 | -0.077 | -0.027 | 0.051 | 0.008 | -0.012 | 0.002 |
| Q11 | 0.071 | -0.133 | 0.001 | 0.063 | 0.046 | -0.095 | 0.138 | -0.082 |
| Q12 | 0.078 | -0.069 | -0.123 | -0.155 | -0.073 | -0.122 | 0.098 | -0.118 |
| Q13 | 0.106 | -0.016 | 0.011 | 0.003 | 0.033 | -0.038 | -0.072 | -0.116 |
| Q14 | -0.070 | -0.078 | -0.021 | 0.045 | -0.011 | -0.024 | -0.024 | -0.041 |
| Q15R | 0.027 | 0.035 | 0.066 | 0.018 | -0.040 | -0.013 | 0.020 | 0.064 |
| Q16R | -0.069 | 0.051 | 0.025 | 0.025 | -0.160 | 0.042 | -0.028 | 0.019 |
|  | Q | Q10 |  |  |  |  |  |  |
| Q9 | 0.907 |  |  |  |  |  |  |  |
| Q10 | -0.032 | 0.963 |  |  |  |  |  |  |
| Q11 | -0.098 | -0.091 | 0.933 |  |  |  |  |  |
| Q12 | -0.020 | -0.049 | -0.016 | 0.923 |  |  |  |  |
| Q13 | 0.004 | 0.017 | -0.009 | -0.007 | 0.963 |  |  |  |
| Q14 | -0.008 | -0.049 | -0.107 | -0.042 | -0.192 | 0.939 |  |  |
| Q15R | 0.050 | -0.065 | 0.062 | 0.016 | -0.013 | -0.010 | 0.828 |  |
| Q16R | 0.004 | 0.003 | 0.064 | -0.079 | -0.035 | -0.195 | 0.009 | 0.887 |
|  | Q1 | Q2 | Q3 | Q4 | Q5R | Q6 | Q7 | Q8 |
| Q17 | -0.084 | 0.052 | -0.041 | -0.206 | -0.126 | -0.076 | 0.082 | -0.261 |
| Q18 | -0.180 | 0.088 | -0.116 | -0.054 | 0.008 | -0.119 | 0.080 | -0.012 |
| Q19 | -0.044 | -0.014 | -0.096 | -0.010 | 0.107 | -0.154 | -0.016 | 0.054 |
| Q20R | -0.002 | 0.089 | 0.052 | -0.059 | -0.161 | 0.140 | 0.007 | -0.134 |
| Q21 | -0.046 | -0.051 | -0.029 | -0.054 | 0.027 | 0.002 | 0.061 | -0.018 |
| Q22 | 0.082 | 0.051 | 0.013 | -0.059 | 0.036 | 0.013 | -0.028 | 0.087 |
| Q23 | 0.012 | -0.001 | -0.078 | 0.019 | 0.072 | -0.046 | -0.086 | -0.090 |
| Q24R | 0.056 | -0.046 | -0.089 | -0.086 | -0.178 | -0.049 | -0.007 | 0.051 |


|  | Q 9 | Q 10 | Q 11 | Q 12 | Q 13 | Q 14 | Q 15 R | Q 16 R |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Q17 | -0.031 | -0.127 | -0.032 | 0.160 | -0.040 | 0.073 | 0.011 | -0.016 |
| Q18 | -0.088 | 0.000 | -0.036 | -0.171 | 0.006 | -0.015 | 0.010 | -0.077 |
| Q19 | -0.182 | -0.090 | -0.063 | 0.065 | -0.082 | -0.068 | -0.033 | 0.003 |
| Q20 | 0.109 | -0.029 | -0.122 | 0.060 | 0.032 | -0.006 | -0.063 | -0.135 |
| Q21 | 0.019 | -0.033 | 0.004 | -0.154 | -0.096 | 0.072 | -0.013 | 0.035 |
| Q22 | 0.170 | -0.058 | -0.026 | -0.053 | 0.036 | -0.203 | 0.001 | 0.049 |
| Q23 | -0.106 | 0.052 | -0.039 | 0.046 | -0.074 | -0.085 | -0.019 | 0.018 |
| Q24R | 0.089 | 0.079 | -0.064 | 0.118 | -0.064 | -0.034 | -0.201 | -0.012 |
|  |  |  |  |  |  |  |  |  |
|  | Q17 | Q 18 | Q19 | Q20R | Q21 | Q22 | Q23 | Q24R |
| Q17 | 0.930 |  |  |  |  |  |  |  |
| Q18 | -0.211 | 0.929 |  |  |  |  |  |  |
| Q19 | 0.003 | -0.046 | 0.944 |  |  |  |  |  |
| Q20R | 0.064 | 0.041 | -0.068 | 0.840 |  |  |  |  |
| Q21 | 0.050 | -0.005 | -0.008 | 0.015 | 0.884 |  |  |  |
| Q22 | -0.063 | -0.141 | -0.046 | -0.035 | -0.522 | 0.855 |  |  |
| Q23 | -0.061 | -0.046 | 0.051 | -0.029 | -0.125 | -0.046 | 0.932 |  |
| Q24R | 0.015 | -0.027 | -0.050 | -0.221 | -0.044 | 0.046 | -0.124 | 0.876 |
|  |  |  |  |  |  |  |  |  |
|  | Q1 | Q2 | Q3 | Q4 | Q5R | Q6 | Q7 | Q8 |
| Q25R | 0.041 | -0.044 | 0.027 | 0.013 | -0.170 | 0.046 | -0.092 | -0.056 |
| Q26 | -0.045 | -0.138 | -0.088 | 0.00007 | 0.011 | -0.017 | -0.040 | -0.075 |
| Q27 | 0.044 | 0.002 | -0.039 | -0.052 | 0.002 | -0.029 | 0.041 | -0.143 |
| Q28R | -0.042 | -0.140 | -0.096 | 0.013 | -0.190 | -0.120 | 0.078 | -0.016 |
| Q29R | -0.074 | -0.071 | -0.054 | 0.097 | -0.193 | -0.099 | 0.013 | 0.007 |
| Q30 | -0.247 | -0.051 | -0.041 | -0.090 | -0.028 | 0.055 | 0.021 | 0.027 |
| Q31 | -0.153 | 0.084 | -0.181 | -0.072 | -0.025 | -0.064 | 0.011 | -0.046 |
| Q32 | -0.127 | -0.019 | 0.103 | 0.066 | -0.008 | 0.043 | -0.109 | -0.082 |
|  |  |  |  |  |  |  |  |  |
|  | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15R | Q16R |
| Q25R | -0.030 | -0.047 | 0.038 | -0.005 | 0.019 | -0.027 | -0.042 | -0.111 |
| Q26 | -0.190 | 0.022 | 0.061 | -0.013 | -0.045 | -0.149 | -0.011 | 0.081 |
| Q27 | 0.033 | -0.138 | -0.122 | 0.078 | -0.033 | -0.039 | -0.055 | 0.051 |
| Q28R | -0.081 | -0.021 | -0.037 | 0.033 | -0.064 | 0.149 | -0.037 | -0.283 |
| Q29R | 0.071 | -0.063 | 0.059 | -0.009 | 0.021 | 0.010 | -0.095 | -0.062 |
| Q30 | -0.165 | 0.048 | -0.129 | -0.058 | -0.080 | -0.050 | -0.047 | 0.066 |
| Q31 | -0.125 | -0.093 | -0.038 | -0.101 | -0.075 | 0.023 | 0.022 | -0.081 |
| Q32 | -0.218 | 0.012 | -0.008 | -0.204 | -0.098 | 0.011 | 0.117 | 0.014 |
|  |  |  |  |  |  |  |  |  |


|  | Q17 | Q18 | Q19 | Q20R | Q21 | Q22 | Q23 | Q24R |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Q25R | 0.019 | -0.123 | -0.085 | -0.063 | 0.029 | 0.069 | 0.129 | -0.147 |
| Q26 | -0.106 | 0.007 | 0.032 | 0.022 | 0.065 | -0.040 | 0.138 | -0.083 |
| Q27 | -0.110 | 0.076 | 0.000 | -0.022 | 0.001 | -0.074 | 0.064 | 0.038 |
| Q28R | -0.053 | 0.104 | 0.041 | -0.019 | -0.103 | -0.112 | -0.050 | 0.013 |
| Q29R | 0.005 | 0.038 | 0.102 | -0.147 | 0.015 | 0.014 | 0.073 | -0.040 |
| Q30 | -0.058 | 0.115 | -0.126 | 0.103 | 0.007 | -0.125 | -0.060 | 0.036 |
| Q31 | 0.055 | 0.055 | 0.018 | -0.051 | -0.110 | 0.011 | -0.093 | 0.040 |
| Q32 | 0.006 | -0.063 | -0.165 | -0.076 | 0.006 | 0.030 | -0.042 | -0.062 |
|  |  |  |  |  |  |  |  |  |
|  | Q25R | Q26 | Q27 | Q28R | Q29R | Q30 | Q31 | Q32 |
| Q25R | 0.899 |  |  |  |  |  |  |  |
| Q26 | 0.103 | 0.923 |  |  |  |  |  |  |
| Q27 | -0.152 | 0.063 | 0.908 |  |  |  |  |  |
| Q28R | -0.251 | -0.084 | 0.097 | 0.847 |  |  |  |  |
| Q29R | -0.156 | -0.023 | 0.132 | 0.004 | 0.838 |  |  |  |
| Q30 | -0.104 | 0.007 | -0.054 | 0.058 | -0.052 | 0.927 |  |  |
| Q31 | -0.096 | -0.122 | -0.026 | 0.167 | 0.056 | 0.003 | 0.939 |  |
| Q32 | 0.101 | 0.013 | -0.306 | 0.056 | -0.143 | 0.114 | 0.029 | 0.899 |

Table C10
Excerpt of Total Variance Explained Showing EFA Results Based on Eigenvalues

|  | Total Variance Explained |  |  |  |  |  |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: |
| Component | Total | Initial Eigenvalues |  |  |  |  |
| \% of Variance Cumulative \% | Extraction Sums of Squared Loadings |  |  |  |  |  |
| Total | \% of Variance Cumulative \% |  |  |  |  |  |
| 1 | 9.642 | 31.104 | 31.104 | 9.642 | 31.104 | 31.104 |
| 2 | 3.309 | 10.673 | 41.777 | 3.309 | 10.673 | 41.777 |
| 3 | 1.430 | 4.614 | 46.392 | 1.430 | 4.614 | 46.392 |
| 4 | 1.248 | 4.027 | 50.418 | 1.248 | 4.027 | 50.418 |
| 5 | 1.001 | 3.230 | 53.648 | 1.001 | 3.230 | 53.648 |
| 6 | .988 | 3.187 | 56.835 |  |  |  |
| 7 | .896 | 2.891 | 59.726 |  |  |  |
| 8 | .885 | 2.856 | 62.582 |  |  |  |
| 9 | .820 | 2.644 | 65.225 |  |  |  |

Note. SPSS Extraction Method: Principal Component Analysis.

Table C11
Component Matrix ${ }^{a}$

|  | Component |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 2 | 3 | 4 | 5 |
| Q4 | . 731 |  |  |  |  |
| Q8 | . 719 |  |  |  |  |
| Q17 | . 685 |  |  |  |  |
| Q13 | . 646 |  |  |  |  |
| Q14 | . 645 |  |  |  |  |
| Q7 | . 642 |  |  | -. 340 |  |
| Q31 | . 629 |  |  |  |  |
| Q2 | . 626 |  |  | -. 337 |  |
| Q12 | . 626 |  |  |  |  |
| Q18 | . 622 |  |  |  |  |
| Q19 | . 618 |  |  |  |  |
| Q30 | . 606 |  |  |  |  |
| Q32 | . 603 |  | -. 367 |  |  |
| Q1 | . 603 |  |  | -. 359 | . 302 |
| Q10 | . 593 |  |  |  | . 376 |
| Q9 | . 589 |  | -. 402 |  |  |
| Q3 | . 568 |  |  |  | . 318 |
| Q6 | . 546 |  |  |  | -. 403 |
| Q27 | . 544 |  |  | . 321 |  |
| Q26 | . 526 |  |  | -. 389 |  |
| Q11 | . 524 |  |  | . 361 |  |
| Q23 | . 510 |  |  |  |  |
| Q5R | . 345 | . 741 |  |  |  |
| Q29R |  | . 667 |  |  |  |
| Q16R | . 352 | . 623 |  |  |  |
| Q25R | . 456 | . 622 |  |  |  |
| Q20R |  | . 616 |  | . 391 |  |
| Q28R | . 397 | . 568 |  |  |  |
| Q24R | . 348 | . 566 |  |  |  |
| Q22 | . 539 |  | . 601 |  |  |
| Q21 | . 565 |  | . 589 |  |  |

Extraction Method: Principal Component Analysis.
a. 5 components extracted.

Table C12
Comparative Summary of Results for EFA Rotations with Five Factors

| Number of Factors | Rotation | Number of Variables with Cross-loadings | Factors with Primary Loadings | Number of Loadings |
| :---: | :---: | :---: | :---: | :---: |
| 5 | None | 19 | 1 | 22 |
|  |  |  | 2 | 8 |
|  |  |  | 3 | 2 |
|  | Varimax | 16 | 1 | 7 |
|  |  |  | 2 | 7 |
|  |  |  | 3 | 6 |
|  |  |  | 4 | 7 |
|  |  |  | 5 | 4 |
|  | Quartimax | 11 | 1 | 22 |
|  |  |  | 2 | 7 |
|  |  |  | 3 | 2 |
|  | Equamax | 17 | 1 | 7 |
|  |  |  | 2 | 6 |
|  |  |  | 3 | 6 |
|  |  |  | 4 | 6 |
|  |  |  | 5 | 4 |
|  | Direct Oblimin |  | 1 | 9 |
|  | ** note** | 1 variable did | 2 | 7 |
|  |  | not have any | 3 | 5 |
|  |  | loadings $\geq 0.300$ | 4 | 6 |
|  |  |  | 5 | 3 |
|  | Promax | 7 | 1 | 7 |
|  | ** note** | 1 variable did | 2 | 6 |
|  |  | not have any | 3 | 6 |
|  |  | loadings $\geq 0.300$ | 4 | 6 |
|  |  |  | 5 | 4 |

Table C13
Excerpt of Total Variance Explained after Removal of Q14

| Component | Initial Eigenvalues |  |  | Extraction Sums of Squared Loadings |  |  | Rotation <br> Sums of Squared Loadings ${ }^{\text {a }}$ <br> Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Total | \% of Variance | $\begin{gathered} \text { Cumulative } \\ \% \end{gathered}$ | Total | \% of Variance | $\begin{gathered} \text { Cumulative } \\ \% \end{gathered}$ |  |
| 1 | 9.253 | 30.844 | 30.844 | 9.253 | 30.844 | 30.844 | 6.361 |
| 2 | 3.306 | 11.019 | 41.863 | 3.306 | 11.019 | 41.863 | 4.539 |
| 3 | 1.428 | 4.759 | 46.621 | 1.428 | 4.759 | 46.621 | 6.080 |
| 4 | 1.245 | 4.151 | 50.773 | 1.245 | 4.151 | 50.773 | 6.708 |
| 5 | 1.000 | 3.335 | 54.107 | 1.000 | 3.335 | 54.107 | 4.559 |
| 6 | . 973 | 3.244 | 57.351 |  |  |  |  |
| 7 | . 889 | 2.965 | 60.316 |  |  |  |  |
| 8 | . 870 | 2.901 | 63.217 |  |  |  |  |
| 9 | . 799 | 2.663 | 65.880 |  |  |  |  |
| 10 | . 792 | 2.639 | 68.518 |  |  |  |  |

Table C14
Promax Pattern Matrix ${ }^{a}$ after Removal of Q14

|  | Component |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 2 |  | 3 | 4 | 5 |
| Q27 | . 836 |  |  |  |  |  |
| Q11 | . 679 |  |  |  |  |  |
| Q32 | . 669 |  |  |  |  |  |
| Q19 | . 500 |  |  |  |  |  |
| Q10 | . 499 |  |  | . 441 |  |  |
| Q8 | . 482 |  |  |  | . 368 |  |
| Q17 | . 322 |  |  |  | . 315 |  |
| Q5R |  |  | . 806 |  |  |  |
| Q20R |  |  | . 794 |  |  |  |
| Q25R |  |  | . 714 |  |  |  |
| Q24R |  |  | . 706 |  |  |  |
| Q16R |  |  | . 703 |  |  |  |
| Q29R |  |  | . 640 |  |  |  |
| Q28R |  |  | . 638 |  |  |  |
| Q1 |  |  |  | . 765 |  |  |
| Q3 |  |  |  | . 681 |  |  |
| Q2 |  |  |  | . 530 | . 313 |  |
| Q30 |  |  |  | . 442 |  |  |
| Q31 |  |  |  | . 355 |  |  |
| Q6 |  |  |  |  | . 682 |  |
| Q7 |  |  |  |  | . 648 |  |
| Q4 |  |  |  |  | . 568 |  |
| Q9 | . 487 |  |  |  | . 520 |  |
| Q26 |  |  |  | . 425 | . 485 |  |
| Q23 |  |  |  |  | . 471 | . 446 |
| Q13 |  |  |  |  | . 459 |  |
| Q22 |  |  |  |  |  | . 860 |
| Q21 |  |  |  |  |  | . 856 |
| Q12 |  |  |  |  |  | . 314 |
| Q18 |  |  |  |  |  |  |

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 8 iterations.

## Table C15

Excerpt of Total Variance Explained after Removal of Q18

| Component | Initial Eigenvalues |  |  | Extraction Sums of Squared Loadings |  |  | Rotation <br> Sums of <br> Squared Loadings ${ }^{\text {a }}$ <br> Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Total | \% of <br> Variance | $\begin{gathered} \text { Cumulative } \\ \% \end{gathered}$ | Total | \% of Variance | $\begin{gathered} \text { Cumulative } \\ \% \\ \hline \end{gathered}$ |  |
| 1 | 8.891 | 30.659 | 30.659 | 8.891 | 30.659 | 30.659 | 4.491 |
| 2 | 3.295 | 11.363 | 42.022 | 3.295 | 11.363 | 42.022 | 6.021 |
| 3 | 1.424 | 4.909 | 46.931 | 1.424 | 4.909 | 46.931 | 5.791 |
| 4 | 1.244 | 4.291 | 51.222 | 1.244 | 4.291 | 51.222 | 6.443 |
| 5 | 1.000 | 3.450 | 54.672 | 1.000 | 3.450 | 54.672 | 4.146 |
| 6 | . 926 | 3.193 | 57.865 |  |  |  |  |
| 7 | . 882 | 3.040 | 60.905 |  |  |  |  |
| 8 | . 867 | 2.991 | 63.895 |  |  |  |  |
| 9 | . 799 | 2.754 | 66.649 |  |  |  |  |
| 10 | . 761 | 2.624 | 69.273 |  |  |  |  |

Table C16
Promax Pattern Matrix ${ }^{a}$ after Removal of Q18

|  | Component |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 2 | 3 | 4 | 5 |
| Q5R | . 805 |  |  |  |  |
| Q20R | . 794 |  |  |  |  |
| Q25R | . 714 |  |  |  |  |
| Q24R | . 707 |  |  |  |  |
| Q16R | . 702 |  |  |  |  |
| Q29R | . 640 |  |  |  |  |
| Q28R | . 636 |  |  |  |  |
| Q27 |  | . 827 |  |  |  |
| Q11 |  | . 674 |  |  |  |
| Q32 |  | . 660 |  |  |  |
| Q10 |  | . 497 | . 446 |  |  |
| Q19 |  | . 496 |  |  |  |
| Q8 |  | . 477 |  | . 371 |  |
| Q17 |  | . 320 |  | . 319 |  |
| Q1 |  |  | . 758 |  |  |
| Q3 |  |  | . 678 |  |  |
| Q2 |  |  | . 519 | . 317 |  |
| Q30 |  |  | . 440 |  |  |
| Q31 |  |  | . 358 |  |  |
| Q6 |  |  |  | . 680 |  |
| Q7 |  |  |  | . 648 |  |
| Q4 |  |  |  | . 570 |  |
| Q9 |  | . 482 |  | . 519 |  |
| Q26 |  |  | . 416 | . 485 |  |
| Q23 |  |  |  | . 473 | . 447 |
| Q13 |  |  |  | . 460 |  |
| Q21 |  |  |  |  | . 846 |
| Q22 |  |  |  |  | . 845 |
| Q12 |  |  |  |  |  |

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 8 iterations.

Table C17
Excerpt of Total Variance Explained after Removal of Q12

| Component | Initial Eigenvalues |  |  | Extraction Sums of Squared Loadings |  |  | Rotation <br> Sums of Squared Loadings ${ }^{\text {a }}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Total | \% of Variance | $\begin{gathered} \text { Cumulative } \\ \% \end{gathered}$ | Total | \% of Variance | $\begin{gathered} \text { Cumulative } \\ \% \end{gathered}$ | Total |
| 1 | 8.536 | 30.485 | 30.485 | 8.536 | 30.485 | 30.485 | 4.475 |
| 2 | 3.277 | 11.705 | 42.189 | 3.277 | 11.705 | 42.189 | 5.747 |
| 3 | 1.408 | 5.028 | 47.217 | 1.408 | 5.028 | 47.217 | 6.173 |
| 4 | 1.244 | 4.445 | 51.662 | 1.244 | 4.445 | 51.662 | 5.459 |
| 5 | 1.000 | 3.573 | 55.234 | 1.000 | 3.573 | 55.234 | 3.730 |
| 6 | . 915 | 3.268 | 58.502 |  |  |  |  |
| 7 | . 874 | 3.120 | 61.622 |  |  |  |  |
| 8 | . 818 | 2.922 | 64.544 |  |  |  |  |
| 9 | . 773 | 2.761 | 67.305 |  |  |  |  |
| 10 | . 739 | 2.638 | 69.944 |  |  |  |  |

## Table C18

Promax Pattern Matrixa after Removal of Q12


Note. Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 8 iterations.

Table C19
Promax Pattern Matrix ${ }^{a}$ for Four-Factor Model

|  | Component |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 2 |  | 3 |  | 4 |  |
| Q27 | . 811 |  |  |  |  |  |  |
| Q32 | . 798 |  |  |  |  |  |  |
| Q9 | . 722 |  |  |  |  |  |  |
| Q11 | . 692 |  |  |  |  |  |  |
| Q8 | . 640 |  |  |  |  |  |  |
| Q19 | . 582 |  |  |  |  |  |  |
| Q13 | . 462 |  |  |  |  |  |  |
| Q17 | . 429 |  | . 309 |  |  |  |  |
| Q10 | . 354 |  |  |  |  |  |  |
| Q6 | . 347 |  | . 318 |  |  |  |  |
| Q1 |  |  | . 734 |  |  |  |  |
| Q26 |  |  | . 720 |  |  |  |  |
| Q2 |  |  | . 708 |  |  |  |  |
| Q7 |  |  | . 700 |  |  |  |  |
| Q3 |  |  | . 574 |  |  |  |  |
| Q4 |  |  | . 523 |  |  |  |  |
| Q30 |  |  | . 428 |  |  |  |  |
| Q31 |  |  | . 350 |  |  |  |  |
| Q5R |  |  |  |  | . 800 |  |  |
| Q20R |  |  | -. 413 |  | . 796 |  |  |
| Q25R |  |  |  |  | . 719 |  |  |
| Q16R |  |  |  |  | . 700 |  |  |
| Q24R |  |  |  |  | . 682 |  |  |
| Q29R |  |  |  |  | . 653 |  |  |
| Q28R |  |  |  |  | . 620 |  |  |
| Q22 |  |  |  |  |  |  | . 884 |
| Q21 |  |  |  |  |  |  | . 868 |
| Q23 |  |  |  |  |  |  | . 428 |

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

Table C20
Regression Weights for Manifest Variables

|  |  |  | Estimate | S.E. | C.R. | P |
| :--- | :--- | :--- | ---: | ---: | ---: | ---: |
| Q32 | <--- | leadership_collab_envir | 1.000 |  |  |  |
| Q27 | <--- | leadership_collab_envir | 1.080 | .111 | 9.718 | $* * *$ |
| Q19 | <--- | leadership_collab_envir | 1.141 | .113 | 10.097 | $* * *$ |
| Q17 | <--- | leadership_collab_envir | 1.040 | .096 | 10.839 | $* * *$ |
| Q13 | <--- | leadership_collab_envir | 1.168 | .114 | 10.214 | $* * *$ |
| Q11 | <--- | leadership_collab_envir | 1.053 | .117 | 8.981 | $* * *$ |
| Q10 | <--- | leadership_collab_envir | .876 | .093 | 9.437 | $* * *$ |
| Q9 | <--- | leadership_collab_envir | 1.146 | .113 | 10.100 | $* * *$ |
| Q8 | <--- | leadership_collab_envir | 1.124 | .097 | 11.588 | $* * *$ |
| Q6 | <--- | leadership_collab_envir | 1.017 | .113 | 8.979 | $* * *$ |
| Q29R | <--- | organization_accountability | 1.000 |  |  |  |
| Q28R | <--- | organization_accountability | .933 | .103 | 9.096 | $* * *$ |
| Q25R | <--- | organization_accountability | 1.090 | .111 | 9.780 | $* * *$ |
| Q24R | <--- | organization_accountability | .924 | .107 | 8.612 | $* * *$ |
| Q20R | <--- | organization_accountability | .965 | .115 | 8.369 | $* * *$ |
| Q16R | <--- | organization_accountability | .978 | .106 | 9.213 | $* * *$ |
| Q5R | <--- | organization_accountability | 1.175 | .116 | 10.106 | $* * *$ |
| Q23 | <--- | resource_availability | 1.000 |  |  |  |
| Q22 | <--- | resource_availability | 1.592 | .186 | 8.540 | $* * *$ |
| Q21 | <--- | resource_availability | 1.663 | .194 | 8.558 | $* * *$ |
| Q3 | <--- | motivation_learning | .636 | .071 | 8.975 | $* * *$ |
| Q2 | <--- | motivation_learning | .934 | .093 | 10.064 | $* * *$ |
| Q1 | <--- | motivation_learning | .812 | .084 | 9.636 | $* * *$ |
| Q33 | <--- | successful_program | 1.000 |  |  |  |
| Q34 | <--- | successful_program | .980 | .101 | 9.713 | $* * *$ |
| Q35 | <--- | successful_program | 1.010 | .079 | 12.794 | $* * *$ |
| Q7 | <--- | motivation_learning | .906 | .089 | 10.188 | $* * *$ |
| Q4 | <--- | motivation_learning | 1.151 | .107 | 10.806 | $* * *$ |
| Q26 | <--- | motivation_learning | .733 | .085 | 8.592 | $* * *$ |
| Q30 | <--- | motivation_learning | 1.000 |  |  |  |
| Q31 | <--- | motivation_learning | .102 | 9.194 | $* * *$ |  |
|  |  |  |  |  |  |  |

## Table C21

Measurement Model Evaluation for Validity and Reliability

| Descr | $X^{2}$ | $d f$ | $p$-value | CFI | RMSEA | SRMR | PNFI | loadings | CR | AVE | $\begin{gathered} \hline \text { AVE > } \\ \text { MSV } \\ \hline \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| model with all covariances | 804.83 | 422 | < 0.001 | 0.910 | 0.051 | 0.0603 | 0.753 | $\begin{gathered} >0.5 \\ \text { except } \\ \text { Q23 } \\ (0.494) \end{gathered}$ | $\begin{aligned} & \text { all } \\ & >0.7 \end{aligned}$ | lead collab 0.38 org acc 0.43 res avail 0.53 motiv 0.39 success 0.46 | only res <br>  <br> org acc <br> $>$ both <br> msv; <br> lead <br> collab <br> and <br> motiv <br> each $>$ <br> 2 of 3 |
| $\begin{aligned} & \text { removed } \\ & \text { Q11 } \end{aligned}$ | 755.11 | 393 | < 0.001 | 0.912 | 0.051 | 0.0597 | 0.754 | $\begin{gathered} >0.5 \\ \text { except } \\ \text { Q23 } \\ (0.494) \end{gathered}$ | $\begin{aligned} & \text { all } \\ & >0.7 \end{aligned}$ | lead collab 0.39 org acc 0.43 res avail 0.53 motiv 0.39 success | only res <br>  <br> org acc <br> $>$ both <br> MSV; <br> lead <br> collab <br> and <br> motiv <br> each > <br> 2 of 3 |
| $\begin{aligned} & \text { removed } \\ & \text { Q26 } \end{aligned}$ | 705.91 | 365 | $<0.001$ | 0.915 | 0.052 | 0.0603 | 0.755 | $\begin{gathered} >0.5 \\ \text { except } \\ \text { Q23 } \\ (0.494) \end{gathered}$ | $\begin{gathered} \text { all } \\ >0.7 \end{gathered}$ | $\begin{gathered} 0.46 \\ \text { lead } \\ \text { collab } \\ 0.39 \\ \text { org acc } \\ 0.43 \\ \text { res } \\ \text { avail } \\ 0.53 \\ \text { motiv } \\ 0.41 \\ \text { success } \\ 0.46 \end{gathered}$ | only res avail \& org acc $>$ both MSV; lead collab and motiv each > 2 of 3 |
| $\begin{aligned} & \text { removed } \\ & \text { Q6 } \end{aligned}$ | 660.40 | 338 | $<0.001$ | 0.917 | 0.052 | 0.0605 | 0.755 | $\begin{gathered} >0.5 \\ \text { except } \\ \text { Q23 } \\ (0.494) \end{gathered}$ | $\begin{aligned} & \text { all } \\ & >0.7 \end{aligned}$ | lead collab 0.40 org acc 0.43 res avail 0.53 motiv 0.40 success 0.46 | only res <br>  <br> org acc <br> $>$ both <br> MSV; <br> lead <br> collab <br> and <br> motiv <br> each > <br> 2 of 3 |

Table C22
Comparative Results for Bayesian and ML Analysis Methods

|  |  |  | Regression Estimates |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |  |
|  |  | ML | S.E. | Bayesian | S.D. |
|  |  |  |  |  |  |
| Q1 | $\leftarrow$ motivation_learning | 0.809 | 0.083 | 0.840 | 0.089 |
| Q2 | $\leftarrow$ motivation_learning | 0.909 | 0.091 | 0.944 | 0.102 |
| Q3 | $\leftarrow$ motivation_learning | 0.638 | 0.070 | 0.660 | 0.076 |
| Q4 | $\leftarrow$ motivation_learning | 1.103 | 0.103 | 1.142 | 0.114 |
| Q5R | $\leftarrow$ organization_accountability | 1.178 | 0.118 | 1.230 | 0.131 |
| Q7 | $\leftarrow$ motivation_learning | 0.850 | 0.086 | 0.880 | 0.100 |
| Q8 | $\leftarrow$ leadership_collab_envir | 1.194 | 0.112 | 1.242 | 0.120 |
| Q9 | $\leftarrow$ leadership_collab_envir | 1.153 | 0.112 | 1.193 | 0.125 |
| Q10 | $\leftarrow$ leadership_collab_envir | 0.945 | 0.105 | 0.984 | 0.115 |
| Q13 | $\leftarrow$ leadership_collab_envir | 1.239 | 0.129 | 1.292 | 0.142 |
| Q16R | $\leftarrow$ organization_accountability | 0.988 | 0.107 | 1.037 | 0.119 |
| Q17 | $\leftarrow$ leadership_collab_envir | 1.119 | 0.110 | 1.172 | 0.121 |
| Q19 | $\leftarrow$ leadership_collab_envir | 1.174 | 0.127 | 1.219 | 0.137 |
| Q20R | $\leftarrow$ organization_accountability | 0.928 | 0.115 | 0.971 | 0.122 |
| Q21 | $\leftarrow$ resource_availability | 1.664 | 0.194 | 1.670 | 0.203 |
| Q22 | $\leftarrow$ resource_availability | 1.590 | 0.186 | 1.597 | 0.200 |
| Q23 | $\leftarrow$ resource_availability | 1.000 |  | 1.000 |  |
| Q24R | $\leftarrow$ organization_accountability | 0.891 | 0.107 | 0.934 | 0.120 |
| Q25R | $\leftarrow$ organization_accountability | 1.102 | 0.113 | 1.155 | 0.127 |
| Q27 | $\leftarrow$ leadership_collab_envir | 1.109 | 0.109 | 1.150 | 0.121 |
| Q28R | $\leftarrow$ organization_accountability | 0.947 | 0.104 | 0.992 | 0.114 |
| Q29R | $\leftarrow$ organization_accountability | 1.000 |  | 1.000 |  |
| Q30 | $\leftarrow$ motivation_learning | 1.000 |  | 1.000 |  |
| Q31 | $\leftarrow$ motivation_learning | 0.926 | 0.100 | 0.969 | 0.112 |
| Q32 | $\leftarrow$ leadership_collab_envir | 1.000 |  | 1.000 |  |
| Q33 | $\leftarrow$ successful_program | 1.000 |  | 1.000 |  |
| Q34 | $\leftarrow$ successful_program | 0.983 | 0.101 | 0.979 | 0.105 |
| Q35 | $\leftarrow$ successful_program | 1.000 | 0.079 | 0.995 | 0.080 |

Table C23
Variance Estimates

|  | Variances |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
|  | ML | S.E. | Bayesian | S.D. |
| D1 | 0.027 | 0.018 | 0.028 | 0.018 |
| D2 | 0.157 | 0.036 | 0.163 | 0.035 |
| e1 | 0.268 | 0.022 | 0.273 | 0.023 |
| e2 | 0.297 | 0.025 | 0.304 | 0.026 |
| e3 | 0.219 | 0.018 | 0.224 | 0.019 |
| e4 | 0.313 | 0.027 | 0.323 | 0.029 |
| e5 | 0.416 | 0.044 | 0.430 | 0.047 |
| e7 | 0.278 | 0.023 | 0.285 | 0.024 |
| e8 | 0.275 | 0.025 | 0.281 | 0.026 |
| e9 | 0.591 | 0.048 | 0.608 | 0.050 |
| e10 | 0.411 | 0.033 | 0.418 | 0.035 |
| e13 | 0.551 | 0.046 | 0.562 | 0.048 |
| e16 | 0.576 | 0.051 | 0.584 | 0.051 |
| e17 | 0.327 | 0.028 | 0.333 | 0.028 |
| e19 | 0.571 | 0.047 | 0.581 | 0.049 |
| e20 | 0.955 | 0.079 | 0.980 | 0.080 |
| e21 | 0.294 | 0.051 | 0.303 | 0.048 |
| e22 | 0.387 | 0.051 | 0.398 | 0.048 |
| e23 | 0.803 | 0.065 | 0.813 | 0.069 |
| e24 | 0.772 | 0.064 | 0.790 | 0.066 |
| e25 | 0.474 | 0.046 | 0.481 | 0.047 |
| e27 | 0.592 | 0.048 | 0.606 | 0.048 |
| e28 | 0.561 | 0.049 | 0.573 | 0.051 |
| e29 | 1.094 | 0.090 | 1.124 | 0.095 |
| e30 | 0.496 | 0.040 | 0.508 | 0.042 |
| e31 | 0.437 | 0.035 | 0.443 | 0.036 |
| e32 | 0.439 | 0.036 | 0.446 | 0.038 |
| e33 | 0.237 | 0.023 | 0.242 | 0.024 |
| e34 | 0.617 | 0.051 | 0.629 | 0.053 |
| e35 | 0.260 | 0.025 | 0.267 | 0.026 |
|  |  |  |  |  |

Table C24
Covariance Estimates

|  | Covariances |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | ML | S.E. | Bayesian | S.D. |
| motivation_learning $\leftrightarrow$ leadership_ collab_envir | 0.231 | 0.031 | 0.223 | 0.032 |
| leadership_collab_envir $\leftrightarrow$ organization accountability | 0.112 | 0.026 | 0.107 | 0.025 |
| motivation_learning $\leftrightarrow$ organization_ accountability | 0.170 | 0.032 | 0.164 | 0.032 |
| $\mathrm{e} 24 \leftrightarrow \mathrm{e} 20$ | 0.181 | 0.052 | 0.187 | 0.055 |
| $\mathrm{e} 32 \leftrightarrow$ e27 | 0.116 | 0.030 | 0.120 | 0.029 |
| $\mathrm{e} 7 \leftrightarrow \mathrm{e} 4$ | 0.097 | 0.019 | 0.100 | 0.020 |
| $\mathrm{e} 32 \leftrightarrow \mathrm{e} 9$ | 0.105 | 0.029 | 0.109 | 0.031 |

Table C25
Comparison of 95\% Confidence Intervals for Bayesian and ML Analysis Methods

|  |  | Regression Estimates |  |
| :--- | :--- | :--- | :--- |
|  |  | ML | Bayesian |
|  |  |  |  |
| Q1 | $\leftarrow$ motivation_learning | $(0.6460,0.9720)$ | $(0.6652,1.0148)$ |
| Q2 | $\leftarrow$ motivation_learning | $(0.7303,1.0877)$ | $(0.7437,1.1443)$ |
| Q3 | $\leftarrow$ motivation_learning | $(0.5005,0.7755)$ | $(0.5107,0.8093)$ |
| Q4 | $\leftarrow$ motivation_learning | $(0.9007,1.3053)$ | $(0.9181,1.3659)$ |
| Q5R | $\leftarrow$ organization_accountability | $(0.9462,1.4098)$ | $(0.9727,1.4873)$ |
| Q7 | $\leftarrow$ motivation_learning | $(0.6811,1.0189)$ | $(0.6836,1.0764)$ |
| Q8 | $\leftarrow$ leadership_collab_envir | $(0.9740,1.4140)$ | $(1.0063,1.4778)$ |
| Q9 | $\leftarrow$ leadership_collab_envir | $(0.9330,1.3730)$ | $(0.9475,1.4385)$ |
| Q10 | $\leftarrow$ leadership_collab_envir | $(0.7388,1.1512)$ | $(0.7581,1.2099)$ |
| Q13 | $\leftarrow$ leadership_collab_envir | $(0.9856,1.4924)$ | $(1.0131,1.5709)$ |
| Q16R | $\leftarrow$ organization_accountability | $(0.7779,1.1981)$ | $(0.8033,1.2707)$ |
| Q17 | $\leftarrow$ leadership_collab_envir | $(0.9030,1.3350)$ | $(0.9344,1.4096)$ |
| Q19 | $\leftarrow$ leadership_collab_envir | $(0.9246,1.4234)$ | $(0.9499,1.4881)$ |
| Q20R | $\leftarrow$ organization_accountability | $(0.7021,1.1539)$ | $(0.7314,1.2106)$ |
| Q21 | $\leftarrow$ resource_mgt | $(1.2830,2.0450)$ | $(1.2713,2.0687)$ |
| Q22 | $\leftarrow$ resource_mgt | $(1.2247,19553)$ | $(1.2042,1.9898)$ |
| Q23 | $\leftarrow$ resource_mgt | 1.000 | 1.000 |
| Q24R | $\leftarrow$ organization_accountability | $(0.6809,1.1011)$ | $(0.6983,1.1697)$ |
| Q25R | $\leftarrow$ organization_accountability | $(0.8801,1.3239)$ | $(0.9193,1.3907)$ |
| Q27 | $\leftarrow$ leadership_collab_envir | $(0.8949,1.3231)$ | $(0.9124,1.3876)$ |
| Q28R | $\leftarrow$ organization_accountability | $(0.7427,1.1513)$ | $(0.7681,1.2159)$ |
| Q29R | $\leftarrow$ organization_accountability | 1.000 | 1.000 |
| Q30 | $\leftarrow$ motivation_learning | 1.000 | 1.000 |
| Q31 | $\leftarrow$ motivation_learning | $(0.7296,1.1224)$ | $(0.7490,1.1890)$ |
| Q32 | $\leftarrow$ leadership_collab_envir | 1.000 | 1.000 |
| Q33 | $\leftarrow$ successful_program | 1.000 | 1.000 |
| Q34 | $\leftarrow$ successful_program | $(0.7846,1.1814)$ | $(0.7728,1.1852)$ |
| Q35 | $\leftarrow$ successful_program | $(0.8448,1.1552)$ | $(0.8379,1.1521)$ |

Table C26
Comparison of 99\% Confidence Intervals for Bayesian and ML Analysis Methods

|  |  | Regression Estimates |  |
| :--- | :--- | :--- | :--- |
|  |  | ML | Bayesian |
|  |  |  |  |
| Q1 | $\leftarrow$ motivation_learning | $(0.5944,1.0236)$ | $(0.6099,1.0701)$ |
| Q2 | $\leftarrow$ motivation_learning | $(0.6738,1.1442)$ | $(0.6803,1.2077)$ |
| Q3 | $\leftarrow$ motivation_learning | $(0.4571,0.8190)$ | $(0.4635,0.8565)$ |
| Q4 | $\leftarrow$ motivation_learning | $(0.8367,1.3693)$ | $(0.8473,1.4367)$ |
| Q5R | $\leftarrow$ organization_accountability | $(0.8730,1.4830)$ | $(0.8914,1.5686)$ |
| Q7 | $\leftarrow$ motivation_learning | $(0.6277,1.0723)$ | $(0.6215,1.1385)$ |
| Q8 | $\leftarrow$ leadership_collab_envir | $(0.9045,1.4835)$ | $(0.9318,1.5522)$ |
| Q9 | $\leftarrow$ leadership_collab_envir | $(0.8635,1.4425)$ | $(0.8699,1.5161)$ |
| Q10 | $\leftarrow$ leadership_collab_envir | $(0.6736,1.2164)$ | $(0.6867,1.2813)$ |
| Q13 | $\leftarrow$ leadership_collab_envir | $(0.9055,1.5725)$ | $(0.9249,1.6591)$ |
| Q16R | $\leftarrow$ organization_accountability | $(0.7114,1.2646)$ | $(0.7294,1.3446)$ |
| Q17 | $\leftarrow$ leadership_collab_envir | $(0.8347,1.4034)$ | $(0.8592,1.4849)$ |
| Q19 | $\leftarrow$ leadership_collab_envir | $(0.8457,1.5023)$ | $(0.8649,1.5731)$ |
| Q20R | $\leftarrow$ organization_accountability | $(0.6307,1.2253)$ | $(0.6556,1.2864)$ |
| Q21 | $\leftarrow$ resource_mgt | $(1.1625,2.1655)$ | $(1.1452,2.1948)$ |
| Q22 | $\leftarrow$ resource_mgt | $(1.1092,2.0708)$ | $(1.0800,2.1140)$ |
| Q23 | $\leftarrow$ resource_mgt | 1.000 | 1.000 |
| Q24R | $\leftarrow$ organization_accountability | $(0.6144,1.1676)$ | $(0.6238,1.2442)$ |
| Q25R | $\leftarrow$ organization_accountability | $(0.8099,1.3941)$ | $(0.8448,1.4652)$ |
| Q27 | $\leftarrow$ leadership_collab_envir | $(0.8272,1.3908)$ | $(0.8372,1.4628)$ |
| Q28R | $\leftarrow$ organization_accountability | $(0.6782,1.2158)$ | $(0.6973,1.2867)$ |
| Q29R | $\leftarrow$ organization_accountability | 1.000 | 1.000 |
| Q30 | $\leftarrow$ motivation_learning | 1.000 | 1.000 |
| Q31 | $\leftarrow$ motivation_learning | $(0.6675,1.1845)$ | $(0.6795,1.2585)$ |
| Q32 | $\leftarrow$ leadership_collab_envir | 1.000 | 1.000 |
| Q33 | $\leftarrow$ successful_program | 1.000 | 1.000 |
| Q34 | $\leftarrow$ successful_program | $(0.7219,1.2441)$ | $(0.7076,1.2504)$ |
| Q35 | $\leftarrow$ successful_program | $(0.7958,1.2042)$ | $(0.7882,1.2018)$ |

Table C27
Comparison of 95\% Confidence Intervals for Variance Estimates

|  | Variances |  |
| :--- | :--- | :--- |
|  | ML | Bayesian |
| D1 | $(-0.0084,0.0624)$ | $(-0.0074,0.0634)$ |
| D2 | $(0.0863,0.2277)$ | $(0.0943,0.2317)$ |
| e1 | $(0.2248,0.3112)$ | $(0.2529,0.3551)$ |
| e2 | $(0.2479,0.3461)$ | $(0.2529,0.3551)$ |
| e3 | $(0.1836,0.2544)$ | $(0.1867,0.2613)$ |
| e4 | $(0.2600,0.3660)$ | $(0.2660,0.3800)$ |
| e5 | $(0.3296,0.5024)$ | $(0.3377,0.5223)$ |
| e7 | $(0.2328,0.3232)$ | $(0.2379,0.3321)$ |
| e8 | $(0.2259,0.3241)$ | $(0.2299,0.3321)$ |
| e9 | $(0.4967,0.6853)$ | $(0.5098,0.7062)$ |
| e10 | $(0.3462,0.4758)$ | $(0.3493,0.4867)$ |
| e13 | $(0.4607,0.6413)$ | $(0.4677,0.6563)$ |
| e16 | $(0.4758,0.6762)$ | $(0.4838,0.6842)$ |
| e17 | $(0.2720,0.3820)$ | $(0.2780,0.3880)$ |
| e19 | $(0.4787,0.6633)$ | $(0.4848,0.6772)$ |
| e20 | $(0.7998,1.1102)$ | $(0.8229,1.1371)$ |
| e21 | $(0.1938,0.3942)$ | $(0.2087,0.3973)$ |
| e22 | $(0.2868,0.4872)$ | $(0.3037,0.4923)$ |
| e23 | $(0.6753,0.9307)$ | $(0.6775,0.9485)$ |
| e24 | $(0.6463,0.8977)$ | $(0.6604,0.9196)$ |
| e25 | $(0.3837,0.5643)$ | $(0.3887,0.5733)$ |
| e27 | $(0.4977,0.6863)$ | $(0.5117,0.7003)$ |
| e28 | $(0.4648,0.6572)$ | $(0.4728,0.6732)$ |
| e29 | $(0.9172,1.2708)$ | $(0.9374,1.3106)$ |
| e30 | $(0.4174,0.5746)$ | $(0.4255,0.5905)$ |
| e31 | $(0.3683,0.5057)$ | $(0.3723,0.5137)$ |
| e32 | $(0.3683,0.5097)$ | $(0.3714,0.5206)$ |
| e33 | $(0.1918,0.2822)$ | $(0.1949,0.2891)$ |
| e34 | $(0.5168,0.7172)$ | $(0.5249,0.7331)$ |
| e35 | $(0.2109,0.3091)$ | $(0.2159,0.3181)$ |

Table C28
Comparison of 99\% Confidence Intervals for Variance Estimates

|  | Variances |  |
| :--- | :--- | :--- |
|  | ML | Bayesian |
| D1 | $(-0.0195,0.0735)$ | $(-0.0185,0.0745)$ |
| D2 | $(0.0639,0.2501)$ | $(0.0725,0.2535)$ |
| e1 | $(0.2111,0.3249)$ | $(0.2368,0.3712)$ |
| e2 | $(0.2324,0.3616)$ | $(0.2368,0.3712)$ |
| e3 | $(0.1725,0.2655)$ | $(0.1749,0.2731)$ |
| e4 | $(0.2432,0.3828)$ | $(0.2480,0.3980)$ |
| e5 | $(0.3023,0.5297)$ | $(0.3085,0.5515)$ |
| e7 | $(0.2185,0.3375)$ | $(0.2230,0.3470)$ |
| e8 | $(0.2104,0.3396)$ | $(0.2138,0.3482)$ |
| e9 | $(0.4669,0.7151)$ | $(0.4788,0.7373)$ |
| e10 | $(0.3257,0.4863)$ | $(0.3275,0.5085)$ |
| e13 | $(0.4321,0.6699)$ | $(0.4379,0.6861)$ |
| e16 | $(0.4442,0.7078)$ | $(0.4522,0.7158)$ |
| e17 | $(0.2546,0.3994)$ | $(0.2606,0.4054)$ |
| e19 | $(0.4495,0.6925)$ | $(0.4543,0.7077)$ |
| e20 | $(0.7508,1.1592)$ | $(0.7732,1.1868)$ |
| e21 | $(0.1622,0.4258)$ | $(0.1789,0.4271)$ |
| e22 | $(0.2552,0.5188)$ | $(0.2739,0.5221)$ |
| e23 | $(0.6350,0.9710)$ | $(0.6346,0.9914)$ |
| e24 | $(0.6066,0.9374)$ | $(0.6194,0.9606)$ |
| e25 | $(0.3551,0.5929)$ | $(0.3595,0.6025)$ |
| e27 | $(0.4679,0.7161)$ | $(0.4819,0.7301)$ |
| e28 | $(0.4343,0.6877)$ | $(0.4412,0.7048)$ |
| e29 | $(0.8614,1.3267)$ | $(0.8784,1.3696)$ |
| e30 | $(0.3926,0.5994)$ | $(0.3994,0.6166)$ |
| e31 | $(0.3465,0.5275)$ | $(0.3499,0.5361)$ |
| e32 | $(0.3459,0.5321)$ | $(0.3478,0.5442)$ |
| e33 | $(0.1775,0.2965)$ | $(0.1800,0.3040)$ |
| e34 | $(0.4852,0.7488)$ | $(0.4920,0.7660)$ |
| e35 | $(0.1954,0.3246)$ | $(0.1998,0.3342)$ |

Table C29
Comparison of 95\% Confidence Intervals for Covariance Estimates

|  | Covariances |  |
| :---: | :---: | :---: |
|  | ML | Bayesian |
| motivation_learning $\leftrightarrow$ leadership_ collab_envir | (0.1701, 0.2919) | (0.1602, 0.2858) |
| leadership_collab_envir $\leftrightarrow$ organization accountability | (0.0609, 0.1631) | (0.0579, 0.1561) |
| motivation_learning $\leftrightarrow$ organization accountability | (0.1072, 0.2328) | (0.1012, 0.2268) |
| $\mathrm{e} 24 \leftrightarrow \mathrm{e} 20$ | (0.0789, 0.2831) | (0.0790, 0.2950) |
| $\mathrm{e} 32 \leftrightarrow \mathrm{e} 27$ | (0.0571, 0.1749) | (0.0630, 0.1770) |
| $\mathrm{e} 7 \leftrightarrow \mathrm{e} 4$ | (0.0597, 0.1343) | (0.0607, 0.1393) |
| $\mathrm{e} 32 \leftrightarrow \mathrm{e} 9$ | (0.0480, 0.1620) | (0.0481, 0.1699$)$ |

Table C30
Comparison of 99\% Confidence Intervals for Covariance Estimates

|  | Covariances |  |
| :---: | :---: | :---: |
|  | ML | Bayesian |
| motivation_learning $\leftrightarrow$ leadership_ collab_envir | (0.1509, 0.3111) | (0.1403, 0.3057) |
| leadership_collab_envir $\leftrightarrow$ organization accountability | (0.0448, 0.1792) | (0.0424, 0.1716) |
| motivation_learning $\leftrightarrow$ organization accountability | (0.0873, 0.2527) | (0.0813, 0.2467) |
| $\mathrm{e} 24 \leftrightarrow \mathrm{e} 20$ | (0.0466, 0.3154) | (0.0448, 0.3292) |
| $\mathrm{e} 32 \leftrightarrow \mathrm{e} 27$ | (0.0385, 0.1936) | (0.0450, 0.1950) |
| $\mathrm{e} 7 \leftrightarrow \mathrm{e} 4$ | (0.0479, 0.1461) | (0.0483, 0.1517) |
| $\mathrm{e} 32 \leftrightarrow \mathrm{e} 9$ | (0.0300, 0.1800) | (0.0289, 0.1891) |

## Table C31

## Estimated Regression Coefficients

|  |  |  | Estimate | S.E. | C.R. | P |
| :--- | :--- | :--- | ---: | ---: | ---: | :---: |
| motivation_learning | <--- | leadership_collab_envir | .687 | .092 | 7.495 | $* * *$ |
| motivation_learning | ---- | organization_accountability | .170 | .037 | 4.623 | $* * *$ |
| motivation_learning | <--- | resource_availability | .232 | .062 | 3.737 | $* * *$ |
| successful_program | <--- | motivation_learning | .970 | .092 | 10.500 | $* * *$ |
| Q32 | <--- | leadership_collab_envir | 1.000 |  |  |  |
| Q27 | <--- | leadership_collab_envir | 1.106 | .107 | 10.290 | $* * *$ |
| Q19 | <--- | leadership_collab_envir | 1.153 | .124 | 9.309 | $* * *$ |
| Q17 | <--- | leadership_collab_envir | 1.109 | .107 | 10.325 | $* * *$ |
| Q13 | <--- | leadership_collab_envir | 1.216 | .126 | 9.618 | $* * *$ |
| Q10 | <--- | leadership_collab_envir | .924 | .102 | 9.034 | $* * *$ |
| Q9 | <--- | leadership_collab_envir | 1.160 | .111 | 10.406 | $* * *$ |
| Q8 | <--- | leadership_collab_envir | 1.194 | .109 | 10.912 | $* * *$ |
| Q29R | <--- | organization_accountability | 1.000 |  |  |  |
| Q28R | <--- | organization_accountability | .943 | .104 | 9.088 | $* * *$ |
| Q25R | <--- | organization_accountability | 1.104 | .113 | 9.768 | $* * *$ |
| Q24R | <--- | organization_accountability | .891 | .107 | 8.321 | $* * *$ |
| Q20R | <--- | organization_accountability | .927 | .115 | 8.056 | $* * *$ |
| Q16R | <--- | organization_accountability | .986 | .107 | 9.193 | $* * *$ |
| Q5R | <--- | resource_availability | 1.178 | .117 | 10.033 | $* * *$ |
| Q23 | <--- | resource_availability | 1.000 |  |  |  |
| Q22 | <--- | resource_availability | 1.588 | .185 | 8.588 | $* * *$ |
| Q21 | <--- | motivation_learning | 1.664 | .193 | 8.633 | $* * *$ |
| Q3 | <--- | motivation_learning | .641 | .070 | 9.176 | $* * *$ |
| Q2 | <--- | motivation_learning | .909 | .091 | 10.042 | $* * *$ |
| Q1 | <--- | successful_program | 1.008 | .083 | 9.751 | $* * *$ |
| Q33 | <--- | successful_program | .973 | .099 | 9.854 | $* * *$ |
| Q34 | <--- | successful_program | .978 | .077 | 12.712 | $* * *$ |
| Q35 | <--- | motivation_learning | .846 | .086 | 9.837 | $* * *$ |
| Q7 | <--- | motivation_learning | 1.104 | .103 | 10.680 | $* * *$ |
| Q4 | <---- | motivation_learning | 1.000 |  |  |  |
| Q30 | motivation_learning | .928 | .100 | 9.289 | $* * *$ |  |
| Q31 |  |  |  |  |  |  |

Table C32
Variance Estimates

|  | Estimate | S.E. | C.R. | P | Label |
| :--- | :---: | :---: | :---: | :---: | :--- |
| leadership_collab_envir | .252 | .043 | 5.885 | $* * *$ | par_63 |
| organization_accountability | .493 | .094 | 5.274 | $* * *$ | par_64 |
| resource_availability | .259 | .058 | 4.508 | $* * *$ | par_65 |
| D3 | .054 | .012 | 4.364 | $* * *$ | par_66 |
| D1 | .034 | .015 | 2.230 | .026 | par_67 |
| e32 | .432 | .036 | 12.083 | $* * *$ | par_68 |
| e27 | .584 | .048 | 12.211 | $* * *$ | par_69 |
| e19 | .573 | .047 | 12.136 | $* * *$ | par_70 |
| e17 | .323 | .028 | 11.437 | $* * *$ | par_71 |
| e13 | .553 | .046 | 11.971 | $* * *$ | par_72 |
| e10 | .414 | .034 | 12.259 | $* * *$ | par_73 |
| e9 | .577 | .048 | 12.096 | $* * *$ | par_74 |
| e8 | .263 | .025 | 10.679 | $* * *$ | par_75 |
| e29 | 1.094 | .090 | 12.212 | $* * *$ | par_76 |
| e28 | .564 | .049 | 11.478 | $* * *$ | par_77 |
| e25 | .472 | .046 | 10.342 | $* * *$ | par_78 |
| e24 | .772 | .064 | 12.030 | $* * *$ | par_79 |
| e20 | .955 | .079 | 12.167 | $* * *$ | par_80 |
| e16 | .578 | .051 | 11.356 | $* * *$ | par_81 |
| e5 | .414 | .044 | 9.494 | $* * *$ | par_82 |
| e23 | .803 | .065 | 12.343 | $* * *$ | par_83 |
| e22 | .389 | .050 | 7.814 | $* * *$ | par_84 |
| e21 | .293 | .049 | 6.001 | $* * *$ | par_85 |
| e30 | .495 | .040 | 12.369 | $* * *$ | par_86 |
| e7 | .279 | .023 | 12.050 | $* * *$ | par_87 |
| e4 | .311 | .027 | 11.506 | $* * *$ | par_88 |
| e3 | .218 | .018 | 12.424 | $* * *$ | par_89 |
| e2 | .296 | .025 | 12.042 | $* * *$ | par_90 |
| e1 | .268 | .022 | 12.193 | $* * *$ | par_91 |
| e33 | .231 | .023 | 9.946 | $* * *$ | par_92 |
| e34 | .616 | .051 | 12.186 | $* * *$ | par_93 |
| e35 | .267 | .025 | 10.605 | $* * *$ | par_94 |
| e31 | .435 | .035 | 12.385 | $* * *$ | par_95 |
|  |  |  |  |  |  |

Table C33
Covariance Estimates

|  |  |  | Est | S.E. | C.R. | P |
| :--- | :--- | :--- | :---: | :---: | :---: | :---: |
| leadership_collab_- <br> envir | $<-->$ | organization_accountability | .113 | .026 | 4.318 | $* * *$ |
| resource_availability | <--> | leadership_collab_envir | .148 | .026 | 5.693 | $* * *$ |
| resource_availability | <--> | organization_accountability | .055 | .024 | 2.266 | .023 |
| e24 | <--> | e20 | .181 | .052 | 3.477 | $* * *$ |
| e32 | <--> | e27 | .110 | .029 | 3.729 | $* * *$ |
| e7 | <--> | e4 | .097 | .019 | 5.086 | $* * *$ |
| e32 | <--> | e9 | .096 | .029 | 3.312 | $* * *$ |

Table C34
Demographic Subgroups in the Sample with Frequencies Less than 30

| Variable | Subgroup | Frequency |
| :---: | :---: | :---: |
| Race | Hispanic | 18 |
|  | Asian or Pacific Islander | 12 |
|  | American Indian or Alaskan | 3 |
|  | Multiple Ethnicity or Other | 12 |
| Role | Alumni | 25 |
|  | Core Content Teacher | 9 |
|  | School Staff | 7 |
|  | Parent or Guardian | 14 |
|  | Advisory Board Member | 13 |
|  | Industry Member / Program | 15 |
|  | Mentor <br> Other (unspecified) | 2 |
| Class or Grade Level | Freshman | 12 |
|  | Sophomore | 21 |
|  | Senior | 24 |
| Student Years in Program | At least 1 but not more than 2 | 13 |
|  | At least 2 but not more than 3 | 10 |
|  | At least 4 | 12 |
| Estimated High School GPA | At least 2.00 but not more than 3.00 | 15 |
|  | At least 4.00 | 25 |
| Estimated CTE GPA | At least 2.00 but not more than 3.00 | 6 |
| Estimated Household Income | \$0 to \$24,999 | 6 |
|  | \$125,000 to \$149,999 | 25 |
|  | \$150,000 to \$174,999 | 25 |
|  | \$175,000 to \$199,999 | 1 |
|  | At least \$200,000 | 21 |

## APPENDIX D

## Figures

D1 Conceptual Model of the Career Academy Approach

D2 Relationship between Confirmatory Factor Model (CFA) and Structural Equation Model

D3 Demographics of Sample

D4 Demographics of Sample

D5 Demographics of Sample

D6 Frequencies of Responses for Survey Item \#1

D7 Frequencies of Responses for Survey Item \#1

D8 Frequencies of Responses for Survey Item \#2

D9 Frequencies of Responses for Survey Item \#2

D10 Frequencies of Responses for Survey Item \#3

D11 Frequencies of Responses for Survey Item \#3

D12 Frequencies of Responses for Survey Item \#4

D13 Frequencies of Responses for Survey Item \#4

D14 Frequencies of Responses for Survey Item \#5R

D15 Frequencies of Responses for Survey Item \#5R

D16 Frequencies of Responses for Survey Item \#6

D17 Frequencies of Responses for Survey Item \#6

D18 Frequencies of Responses for Survey Item \#7

D19 Frequencies of Responses for Survey Item \#7

D20 Frequencies of Responses for Survey Item \#8

D21 Frequencies of Responses for Survey Item \#8

D22 Frequencies of Responses for Survey Item \#9

D23 Frequencies of Responses for Survey Item \#9

D24 Frequencies of Responses for Survey Item \#10

D25 Frequencies of Responses for Survey Item \#10

D26 Frequencies of Responses for Survey Item \#11

D27 Frequencies of Responses for Survey Item \#11

D28 Frequencies of Responses for Survey Item \#12

D29 Frequencies of Responses for Survey Item \#12

D30 Frequencies of Responses for Survey Item \#13

D31 Frequencies of Responses for Survey Item \#13

D32 Frequencies of Responses for Survey Item \#14

D33 Frequencies of Responses for Survey Item \#14

D34 Frequencies of Responses for Survey Item \#15R

D35 Frequencies of Responses for Survey Item \#15R

D36 Frequencies of Responses for Survey Item \#16R

D37 Frequencies of Responses for Survey Item \#16R

D38 Frequencies of Responses for Survey Item \#17

D39 Frequencies of Responses for Survey Item \#17

D40 Frequencies of Responses for Survey Item \#18

D41 Frequencies of Responses for Survey Item \#18

D42 Frequencies of Responses for Survey Item \#19

D43 Frequencies of Responses for Survey Item \#19

D44 Frequencies of Responses for Survey Item \#20R

D45 Frequencies of Responses for Survey Item \#20R

D46 Frequencies of Responses for Survey Item \#21

D47 Frequencies of Responses for Survey Item \#21

D48 Frequencies of Responses for Survey Item \#22

D49 Frequencies of Responses for Survey Item \#22

D50 Frequencies of Responses for Survey Item \#23

D51 Frequencies of Responses for Survey Item \#23

D52 Frequencies of Responses for Survey Item \#24R

D53 Frequencies of Responses for Survey Item \#24R

D54 Frequencies of Responses for Survey Item \#25R

D55 Frequencies of Responses for Survey Item \#25R

D56 Frequencies of Responses for Survey Item \#26

D57 Frequencies of Responses for Survey Item \#26

D58 Frequencies of Responses for Survey Item \#27

D59 Frequencies of Responses for Survey Item \#27

D60 Frequencies of Responses for Survey Item \#28R

D61 Frequencies of Responses for Survey Item \#28R

D62 Frequencies of Responses for Survey Item \#29R

D63 Frequencies of Responses for Survey Item \#29R

D64 Frequencies of Responses for Survey Item \#30

D65 Frequencies of Responses for Survey Item \#30

D66 Frequencies of Responses for Survey Item \#31

D67 Frequencies of Responses for Survey Item \#31

D68 Frequencies of Responses for Survey Item \#32

D69 Frequencies of Responses for Survey Item \#32

D70 Frequencies of Responses for Survey Item \#33

D71 Frequencies of Responses for Survey Item \#33

D72 Frequencies of Responses for Survey Item \#34

D73 Frequencies of Responses for Survey Item \#34

D74 Frequencies of Responses for Survey Item \#35

D75 Frequencies of Responses for Survey Item \#35


Figure D1. Conceptual model of the career academy approach. Adapted from Career Academies: Impacts on Students' Initial Transitions to Post-Secondary Education and Employment by J.J. Kemple (2001). NY: Manpower Demonstration Research Corporation (MDRC). Copyright 2001 by MDRC.


Figure D2. Relationship between confirmatory factor model (CFA) and structural equation model. The large rectangles represent the measurement (CFA) component of the model, while the large oval represents the structural component of the model.
Adapted from Structural equation modeling with AMOS by B.M. Byrne (2010). NY: Routledge. Copyright 2010 by Routledge.


Figure D3a. Bar graph depicting Frequencies for Gender of the Sample.


Figure D3c. Bar graph depicting Frequencies for Role groups in the Sample.


Figure D3b. Bar graph depicting Frequencies for Race of the Sample.


Figure D3d. Bar graph depicting Frequencies for Grade Levels of Students in the Sample.

Figure D3. Demographic bar graphs.


Figure D4. Demographic bar graphs.


Figure D5. Bar graph depicting frequencies for estimated hours of program involvement for adults in the sample.



Figure D6b. Stacked bar graph disaggregated for gender

Figure D6a. Bar graph depicting
Frequencies of Responses


Figure D6c. Stacked bar graph disaggregated for race


Figure D6e. Stacked bar graph disaggregated for student grade level


Figure D6d. Stacked bar graph disaggregated for role within program


Figure D6f. Stacked bar graph disaggregated for student years in program

Figure D6. Frequencies of responses for survey item \#1.


Figure D7a.Stacked bar graph disaggregated for student estimated high school GPA


Figure D7c. Stacked bar graph disaggregated for adult estimated household income


Figure D7b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D7d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D7. Frequencies of responses to survey item \#1.


Figure D8a. Bar graph showing Frequencies of Responses


Figure D8c. Stacked bar graph disaggregated for race


Figure D8e. Stacked bar graph disaggregated for student grade level


Figure D8b. Stacked bar graph disaggregated for gender


Figure D8d. Stacked bar graph disaggregated for role in program


Figure $D 8 f$. Stacked bar graph disaggregated for student years in program

Figure D8. Frequencies of responses to survey item \#2.


Figure D9a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D9c. Stacked bar graph disaggregated for adult estimated household income


Figure D9b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D9d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D9. Frequencies of responses for survey item \#2.


Figure D10a. Bar graph showing
Frequencies of Responses


Figure D10c. Stacked bar graph disaggregated for race


Figure D10e. Stacked bar graph disaggregated for student grade level


Figure D10b. Stacked bar graph disaggregated for gender


Figure D10d. Stacked bar graph disaggregated for role in program


Figure D10f. Stacked bar graph disaggregated for student years in program

Figure D10. Frequencies of responses for survey item \#3.


Figure D11a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D11c. Stacked bar graph disaggregated for adult estimated household income
teaches yam high school goals experience learning skill well program flight aviation help allow


Figure D11b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D11d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D1le. Most Repeated Words and Phrases

Figure D11. Frequencies of responses for survey item \#3.


Figure D12a.. Bar graph showing Frequencies of Responses


Figure D12c. Stacked bar graph disaggregated for race


Figure D12e. Stacked bar graph disaggregated for student grade level


Figure D12b. Stacked bar graph disaggregated for gender


Figure D12d. Stacked bar graph disaggregated for role in program


Figure D12f. Stacked bar graph disaggregated for student years in program

Figure D12. Frequencies of responses for survey item \#4.


Figure D13a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D13c. Stacked bar graph disaggregated for adult estimated household income


Figure D13b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D13d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D13. Frequencies of responses for survey item \#4.


Figure D14a. Bar graph showing Frequencies of Responses


Figure D14c. Stacked bar graph disaggregated for race


Figure D14e. Stacked bar graph disaggregated for student grade level


Figure D14b. Stacked bar graph disaggregated for gender


Figure D14d. Stacked bar graph disaggregated for role in program


Figure D14f. Stacked bar graph disaggregated for student years in program

Figure D14. Frequencies of responses for survey item \#5R.


Figure D15a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D15c. Stacked bar graph disaggregated for adult estimated household income


Figure D15b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D15d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D15. Frequencies of responses for survey item \#5R.


Figure D16a. Bar graph showing
Frequencies of Responses


Figure D16c. Stacked bar graph disaggregated for race


Figure D16e. Stacked bar graph disaggregated for student grade level


Figure D16b. Stacked bar graph disaggregated for gender


Figure D16d. Stacked bar graph disaggregated for role in program


Figure D16f. Stacked bar graph disaggregated for student years in program

Figure 16. Frequencies of responses for survey item \#6.


Figure D17a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D17c. Stacked bar graph disaggregated for adult estimated household income


Figure D17b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D17d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D17. Frequencies of responses for survey item \#6.



Figure D18b. Stacked bar graph disaggregated for gender

Figure D18a. Bar graph showing Frequencies of Responses


Figure D18c. Stacked bar graph disaggregated for race


Figure D18e. Stacked bar graph disaggregated for student grade level


Figure D18d. Stacked bar graph disaggregated for role in program


Figure D18f. Stacked bar graph disaggregated for student years in program

Figure D18. Frequencies of responses for survey item \#7.


Figure D19a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D19c. Stacked bar graph disaggregated for adult estimated household income


Figure D19b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D19d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D19. Frequencies of responses for survey item \#7.


Figure D20a. Bar graph showing
Frequencies of Responses


Race
Figure D20c. Stacked bar graph disaggregated for race


Figure D20e. Stacked bar graph disaggregated for student grade level


Figure D20b. Stacked bar graph disaggregated for gender


Figure D20d. Stacked bar graph disaggregated for role in program


Figure D20f. Stacked bar graph disaggregated for student years in program

Figure 20. Frequencies of responses for survey item \#8.


Figure D21a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D21c. Stacked bar graph disaggregated for adult estimated household income


Figure D21b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D21d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D21. Frequencies of responses for survey item \#8.


Figure D22a. Bar graph showing
Frequencies of Responses


Figure D22c. Stacked bar graph disaggregated for race


Figure D22e. Stacked bar graph disaggregated for student grade level


Figure D22b. Stacked bar graph disaggregated for gender


Figure D22d. Stacked bar graph disaggregated for role in program


Figure D22f. Stacked bar graph disaggregated for student years in program

Figure D22. Frequencies of responses for survey item \#9.


Figure D23a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D23c. Stacked bar graph disaggregated for adult estimated household income


Figure D23b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D23d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D23. Frequencies of responses for survey item \#9.


Figure D24a. Bar graph showing
Frequencies of Responses


Figure D24c. Stacked bar graph disaggregated for race


Figure D24e. Stacked bar graph disaggregated for student grade level


Figure D24b. Stacked bar graph disaggregated for gender


Figure D24d. Stacked bar graph disaggregated for role in program


Figure D24f. Stacked bar graph disaggregated for student years in program

Figure D24. Frequencies of responses for survey item \#10.


Figure D25a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D25c. Stacked bar graph disaggregated for adult estimated household income
program members students part Work yes expected volunteer expectations level always end participate


Figure D25b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D25d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D25e. Most Repeated Words and Phrases

Figure D25. Frequencies of responses for survey item \#10.


Q11
Figure D26a. Bar graph showing Frequencies of Responses


Race
Figure D26c. Stacked bar graph disaggregated for race


Figure D26e. Stacked bar graph disaggregated for student grade level


Figure D26b. Stacked bar graph disaggregated for gender


Figure D26d. Stacked bar graph disaggregated for role in program


Figure D26f. Stacked bar graph disaggregated for student years in program

Figure D26. Frequencies of responses to survey item \#11.


Figure D27a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D27c. Stacked bar graph disaggregated for adult estimated household income


Figure D27b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D27d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D27. Frequencies of responses for survey item \#11.


Figure D28a. Bar graph showing Frequencies of Responses


Figure D28c. Stacked bar graph disaggregated for race


Figure D28e. Stacked bar graph disaggregated for student grade level


Figure D28b. Stacked bar graph disaggregated for gender


Figure D28d. Stacked bar graph disaggregated for role in program


Figure D28f. Stacked bar graph disaggregated for student years in program

Figure D28. Frequencies of responses to survey item \#12.


Figure D29a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D29c. Stacked bar graph disaggregated for adult estimated household income
made $_{\text {students }}$ decisions made $_{\text {teachers }}$ decisionsknows information one


Figure D29b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D29d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D29e. Most Repeated Words and Phrases program ${ }_{\text {level }}$ people $_{\text {national }}$ informed best

Figure D29. Frequencies of responses for survey item \#12.


Figure D30a. Bar graph showing Frequencies of Responses


Figure D30c. Stacked bar graph disaggregated for race


Figure D30e. Stacked bar graph disaggregated for student grade level


Figure D30b. Stacked bar graph disaggregated for gender


Figure D30d. Stacked bar graph disaggregated for role in program


Figure D30f. Stacked bar graph disaggregated for student years in program

Figure D30. Frequencies of responses to survey item \#13.


Figure D31a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D31c. Stacked bar graph disaggregated for adult estimated household income


Figure D31b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D31d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D31. Frequencies of responses for survey item \#13.


Figure D32a. Bar graph showing Frequencies of Responses


Race
Figure D32c. Stacked bar graph disaggregated for race


Figure D32e. Stacked bar graph disaggregated for student grade level
Figure D32. Frequencies of responses to survey item \#14.


Figure D33a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D33c. Stacked bar graph disaggregated for adult estimated household income
program take

## concernS answers



Figure D33b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D33d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D33e. Most Repeated Words and Phrases

Figure D33. Frequencies of responses for survey item \#14.


Figure D34a. Bar graph showing Frequencies of Responses


Figure D34c. Stacked bar graph disaggregated for race


Figure D34e. Stacked bar graph disaggregated for student grade level


Figure D34b. Stacked bar graph disaggregated for gender


Figure D34d. Stacked bar graph disaggregated for role in program


Figure D34f. Stacked bar graph disaggregated for student years in program

Figure D34. Frequencies of responses to survey item \#15R.


Figure D35a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D35c. Stacked bar graph disaggregated for adult estimated household income


Figure D35b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D35d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D35. Frequencies of responses for survey item \#15R.



Figure D36b. Stacked bar graph disaggregated for gender


Figure D36d. Stacked bar graph disaggregated for role in program


Figure D36f. Stacked bar graph disaggregated for student years in program

Figure D36. Frequencies of responses to survey item \#16R.


Figure D37a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D37c. Stacked bar graph disaggregated for adult estimated household income


Figure D37b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D37d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D37. Frequencies of responses for survey item \#16R.


Figure D38a. Bar graph showing Frequencies of Responses


Figure D38c. Stacked bar graph disaggregated for race


Figure D38e. Stacked bar graph disaggregated for student grade level


Figure D38b. Stacked bar graph disaggregated for gender


Figure D38d. Stacked bar graph disaggregated for role in program


Figure D38f. Stacked bar graph disaggregated for student years in program

Figure D38. Frequencies of responses to survey item \#17.


Figure D39a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D39c. Stacked bar graph disaggregated for adult estimated household income


Figure D39b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D39d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D39. Frequencies of responses to survey item \#17.


Figure D40a. Bar graph showing Frequencies of Responses


Figure D40c. Stacked bar graph disaggregated for race


Figure D40e. Stacked bar graph disaggregated for student grade level


Figure D40b. Stacked bar graph disaggregated for gender


Figure D40d. Stacked bar graph disaggregated for role in program


Figure D40f. Stacked bar graph disaggregated for student years in program

Figure D40. Frequencies of responses to survey item \#18.


Figure D41a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D41c. Stacked bar graph disaggregated for adult estimated household income

## knowledge different help

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Figure D41b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D41d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D4le. Most Repeated Words and Phrases

Figure D41. Frequencies of responses for survey item \#18.


Figure D42a. Bar graph showing Frequencies of Responses


Figure D42c. Stacked bar graph disaggregated for race


Figure D42e. Stacked bar graph disaggregated for student grade level


Figure D42b. Stacked bar graph disaggregated for gender


Figure D42d. Stacked bar graph disaggregated for role in program


Figure D42f. Stacked bar graph disaggregated for student years in program

Figure D42. Frequencies of responses to survey item \#19.


Figure D43a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D43c. Stacked bar graph disaggregated for adult estimated household income


Figure D43b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D43d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure 43. Frequencies of responses for survey item \#19.


Figure D44a. Bar graph showing Frequencies of Responses


Figure D44c. Stacked bar graph disaggregated for race


Figure D44e. Stacked bar graph disaggregated for student grade level


Figure D44b. Stacked bar graph disaggregated for gender


Figure D44d. Stacked bar graph disaggregated for role in program


Figure D44f. Stacked bar graph disaggregated for student years in program

Figure D44. Frequencies of responses to survey item \#20R.


Figure D45a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D45c. Stacked bar graph disaggregated for adult estimated household income

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Figure D45b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D45d. Stacked bar graph disaggregated for adult estimated hours devoted to program

FigureD45e. Most Repeated Words and Phrases

Figure D45. Frequencies of responses for survey item \#20R.


Figure D46a. Bar graph showing Frequencies of Responses


Figure D46c. Stacked bar graph disaggregated for race


Figure D46e. Stacked bar graph disaggregated for student grade level


Figure D46b. Stacked bar graph disaggregated for gender


Figure D46d. Stacked bar graph disaggregated for role in program


Figure D46f. Stacked bar graph disaggregated for student years in program

Figure D46. Frequencies of responses to survey item \#21.


Figure D47a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D47c. Stacked bar graph disaggregated for adult estimated household income supplies sudeans program funding materials better need year school


Figure D47b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D47d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D47e. Most Repeated Words and Phrases

Figure D47. Frequencies of responses for survey item \#21.


Figure D48a. Bar graph showing Frequencies of Responses


Figure D48c. Stacked bar graph disaggregated for race


Figure D48e. Stacked bar graph disaggregated for student grade level


Figure D48b. Stacked bar graph disaggregated for gender


Figure D48d. Stacked bar graph disaggregated for role in program


Figure D48f. Stacked bar graph disaggregated for student years in program

Figure D48. Frequencies of responses to survey item \#22.


Figure D49a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D49c. Stacked bar graph disaggregated for adult estimated household income available program equipment old technology always resources access need ${ }_{\text {butuct }}$ use

## computers



Figure D49b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D49d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D49e. Most Repeated Words and Phrases

Figure D49. Frequencies of responses for survey item \#22.


Figure D50a. Bar graph showing
Frequencies of Responses


Figure D50c. Stacked bar graph disaggregated for race


Figure D50e. Stacked bar graph disaggregated for student grade level


Figure D50b. Stacked bar graph disaggregated for gender


Figure D50d. Stacked bar graph disaggregated for role in program


Figure D50f. Stacked bar graph disaggregated for student years in program

Figure D50. Frequencies of responses to survey item \#23.


Figure D51a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D51c. Stacked bar graph disaggregated for adult estimated household income

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Figure D51b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D51d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D51e. Most Repeated Words and Phrases

Figure D51. Frequencies of responses for survey item \#23.


Figure D52e. Stacked bar graph disaggregated for student grade level


Figure D52b. Stacked bar graph disaggregated for gender


Figure D52d. Stacked bar graph disaggregated for role in program


Figure D52f. Stacked bar graph disaggregated for student years in program

Figure D52. Frequencies of responses to survey item \#24R.


Figure D53a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D53c. Stacked bar graph disaggregated for adult estimated household income


Figure D53b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D53d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D53. Frequencies of responses for survey item \#24R.



Figure D54b. Stacked bar graph disaggregated for gender


Figure D54d. Stacked bar graph disaggregated for role in program


Figure D54f. Stacked bar graph disaggregated for student years in program
Figure D54e. Stacked bar graph disaggregated for student grade level
Figure D54. Frequencies of responses to survey item \#25R.


Figure D55a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D55c. Stacked bar graph disaggregated for adult estimated household income


Figure D55b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D55d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D55. Frequencies of responses for survey item \#25R.


Figure D56a. Bar graph showing Frequencies of Responses


Figure D56c. Stacked bar graph disaggregated for race


Figure D56e. Stacked bar graph disaggregated for student grade level


Figure D56b. Stacked bar graph disaggregated for gender


Figure D56d. Stacked bar graph disaggregated for role in program


Figure D56f. Stacked bar graph disaggregated for student years in program

Figure D56. Frequencies of responses to survey item \#26.


Figure D57a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D57c. Stacked bar graph disaggregated for adult estimated household income


Figure D57b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D57d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D57. Frequencies of responses for survey item \#26.


Figure D58a. Bar graph showing Frequencies of Responses


Figure D58c. Stacked bar graph disaggregated for race


Figure D58e. Stacked bar graph disaggregated for student grade level


Figure D58b. Stacked bar graph disaggregated for gender


Figure D58d. Stacked bar graph disaggregated for role in program


Figure D58f. Stacked bar graph disaggregated for student years in program

Figure D58. Frequencies of responses to survey item \#27.


Figure D59a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D59c. Stacked bar graph disaggregated for adult estimated household income


Figure D59b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D59d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D59. Frequencies of responses for survey item \#27.


Figure D60. Frequencies of responses to survey item \#28R.


Figure D61a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D61c. Stacked bar graph disaggregated for adult estimated household income


Figure D61b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D61d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D61. Frequencies of responses for survey item \#28R.


Figure D62a. Bar graph showing
Frequencies of Responses


Figure D62c. Stacked bar graph disaggregated for race


Figure D62e. Stacked bar graph disaggregated for student grade level


Figure D62b. Stacked bar graph disaggregated for gender


Figure D62d. Stacked bar graph disaggregated for role in program


Figure D62f. Stacked bar graph disaggregated for student years in program

Figure D62. Frequencies of responses to survey item \#29R.


Figure D63a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D63c. Stacked bar graph disaggregated for adult estimated household income


Figure D63b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D63d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D63. Frequencies of responses for survey item \#29R.



Figure D64b. Stacked bar graph disaggregated for gender

Figure D64a. Bar graph showing Frequencies of Responses


Figure D64c. Stacked bar graph disaggregated for race


Figure D64e. Stacked bar graph disaggregated for student grade level
Figure D64. Frequencies of responses to survey item \#30.


Figure D65a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D65c. Stacked bar graph disaggregated for adult estimated household income


Figure D65b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D65d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D65. Frequencies of responses for survey item \#30.


Figure D66a. Bar graph showing
Frequencies of Responses


Figure D66c. Stacked bar graph disaggregated for race


Figure D66e. Stacked bar graph disaggregated for student grade level


Figure D66b. Stacked bar graph disaggregated for gender


Figure D66d. Stacked bar graph disaggregated for role in program


Figure D66f. Stacked bar graph disaggregated for student years in program

Figure D66. Frequencies of responses to survey item \#31.


Figure D67a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D67c. Stacked bar graph disaggregated for adult estimated household income academy new keeping
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Figure D67b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D67d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D67e. Most Repeated Words and Phrases

Figure D67. Frequencies of responses for survey item \#31.


Figure D68a. Bar graph showing Frequencies of Responses


Figure D68c. Stacked bar graph disaggregated for race


Figure D68e. Stacked bar graph disaggregated for student grade level


Figure D68b. Stacked bar graph disaggregated for gender


Figure D68d. Stacked bar graph disaggregated for role in program


Figure D68f. Stacked bar graph disaggregated for student years in program

Figure D68. Frequencies of responses to survey item \#32.


Figure D69a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D69c. Stacked bar graph disaggregated for adult estimated household income


Figure D69b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D69d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D69. Frequencies of responses for survey item \#32.


Figure D70a. Bar graph showing Frequencies of Responses


Figure D70c. Stacked bar graph disaggregated for race


Figure D70e. Stacked bar graph disaggregated for student grade level


Figure D70b. Stacked bar graph disaggregated for gender


Figure D70d. Stacked bar graph disaggregated for role in program


Figure D70f. Stacked bar graph disaggregated for student years in program

Figure D70. Frequencies of responses to survey item \#33.


Figure D71a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D71c. Stacked bar graph disaggregated for adult estimated household income


Figure D71b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D71d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D71. Frequencies of responses for survey item \#33.


Figure D72a. Bar graph showing
Frequencies of Responses


Figure D72c. Stacked bar graph disaggregated for race


Figure D72e. Stacked bar graph disaggregated for student grade level


Figure D72b. Stacked bar graph disaggregated for gender


Figure D72d. Stacked bar graph disaggregated for role in program


Figure D72f. Stacked bar graph disaggregated for student years in program

Figure D72. Frequencies of responses to survey item \#34.


Figure D73a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D73c. Stacked bar graph disaggregated for adult estimated household income

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Figure D73b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D73d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D73e. Most Repeated Words and Phrases

Figure D73. Frequencies of responses for survey item \#34.


Figure D74a. Bar graph showing Frequencies of Responses


Figure D74c. Stacked bar graph disaggregated for race


Figure D74e. Stacked bar graph disaggregated for student grade level


Figure D74b. Stacked bar graph disaggregated for gender


Figure D74d. Stacked bar graph disaggregated for role in program


Figure D74f. Stacked bar graph disaggregated for student years in program

Figure D74. Frequencies of responses to survey item \#35.


Figure D75a. Stacked bar graph disaggregated for student estimated high school GPA


Figure D75c. Stacked bar graph disaggregated for adult estimated household income


Figure D75b. Stacked bar graph disaggregated for student estimated CTE GPA


Figure D75d. Stacked bar graph disaggregated for adult estimated hours devoted to program

Figure D75. Frequencies of responses for survey item \#35.

## APPENDIX E

35 Common Mistakes Made with SEM

1. Specification of the model after the data are collected rather than before.
2. Omission of causes that are correlated with other variables in a structural model.
3. Failure to have sufficient numbers of indicators of latent variables.
4. Use of psychometrically inadequate measures.
5. Failure to give careful consideration to the question of directionality.
6. Specification of feedback effects in structural models as a way to mask uncertainty about directionality.
7. Overfit of the model.
8. Addition of disturbance or measurement error correlations without substantive reason.
9. Specification that indicators load on more than one factor without substantive reason.
10. Lack of accuracy check for data input or coding.
11. Ignorance of whether the pattern of data loss is random or systematic.
12. Failure to examine distributional characteristics.
13. Failure to screen for outliers.
14. Assumption that all relations are linear without checking.
15. Re-specification of a model based entirely on statistical criteria.
16. Failure to check the accuracy of programming.
17. Analysis of a correlation matrix when it is clearly inappropriate.
18. Analysis of variables so highly correlated that the solution is unstable.
19. Estimation of a very complex model with a small sample.
20. Determination of scales for latent variables inappropriately.
21. Ignorance of the problem of starting values or the choice of grossly inaccurate starting values.
22. Failure to conduct tests of solution uniqueness when identification status is uncertain.
23. Failure to recognize empirical underidentification.
24. Failure to separately evaluate the measurement and structural portions of a hybrid model.
25. Examination of only indices of overall fit; ignoring other types of information about fit.
26. Interpretation of good fit as meaning that the model is proved.
27. Interpretation of good fit as meaning that the endogenous variables are strongly predicted.
28. Too much reliance on significance tests.
29. Interpretation of the standardized solution in inappropriate ways.
30. Failure to consider equivalent models.
31. Failure to consider (nonequivalent) alternative models.
32. Assuming real world applicability of model factors.
33. Belief that a strong analytical method like SEM can compensate for poor study design or slipshod ideas.
34. Failure to report enough information so that readers can reproduce the results.
35. Interpretation of estimates of large direct effects from a structural model as proof of causality.

## APPENDIX F

National Career Academy Coalition Standards with Associated Evaluation Criteria NAF Distinguished Academy Evaluation Criteria

## National Career Academy Coalition Standards with Associated Evaluation Criteria

Standard 1: Defined Mission and Goals - The career academy has a written definition of its mission, goals, and benchmarks. These are developed by and available to the administrators, teachers, students, parents, advisory board, and others involved in the academy. These include at least the following elements:
a. College and career connections: A career academy's aim is to prepare students for post-secondary education and careers. Academies enable students to complete postsecondary entrance academic requirements while exposing them to a vertical segment of the occupations within a career field, encouraging them to aim as high as they wish.
b. Student aspirations: An academy seeks to raise, maintain, and increase the level of students' motivation while in high school by giving a focus to the program of studies that reflects their own talents, aspirations, and interests. Continued personal awareness and exploration, along with curriculum and experiential components and extracurricular choices, also help to provide guidance. The biggest limiting factor in many youths’ future plans is not ability, but how they perceive their future.
c. Student achievement: So as not to become either a bastion of top performers or a dumping ground for unsuccessful students, an academy provides support to all of its students to maintain and increase their achievement in high school. This support comes through close relationships with teachers and fellow students, by mastering rigorous and relevant curriculum, and experience with career and educational options outside the high school, including a strong focus on personalization with a collaborative environment of all stakeholders.
d. Commitment to equity: Each school ensures that the career academy reflects the demographic mix of the school as a whole, including students with disabilities and English language learners.
e. Stakeholder involvement: Stakeholders involved in the career academy have developed the mission and goals. Additionally, there are clear benchmarks for assessing how the mission and goals are met.

Standard 2: Academy Design - An academy has a well-defined design within the high school, reflecting its status as a small learning community.
a. Cross-grade articulation: The academy incorporates at least a two, a three, or an overall four-year experience, ending in the senior year, with strong articulation in its teacher team, curriculum, and instruction across grade levels. An introduction to the academy's encompassing career exploration precedes the academy experience. The academy has a clear program of study that includes a definitive course sequence.
b. Student selection: Entry into the academy is voluntary and accessible to every student. The recruitment/selection process is written and widely available. New students are provided an orientation to the academy based upon their own talents, aspirations, and interests. Parents or guardians participate in this process and approve of the choice made by their son or daughter. Academy enrollment reflects the general high school population, including students with disabilities and English Language learners.
c. Cohort scheduling: Academy classes consist of academy students who take a series of classes together each year. The academy students take at least two courses per grade level as a cohort with at least $80 \%$ of the enrollment in these courses' academy students.
d. Physical space: Where possible, both academic and career and technical education (CTE) academy classrooms are near each other in the high school building. Rooms allow for flexible configurations required by project-based learning.
e. Small size, supportive atmosphere: The academy maintains personalization through limited size, staff teamwork (including counselors, librarian / media specialists, academy-based administrators, and other support staff), and a supportive atmosphere.
f. Academy design planning: There is ample opportunity for the academy staff, advisory board, and others to plan the academy together. The ideal time would be during the school day.

Standard 3: Host Community and High School - Career academies exist in a variety of district and high school contexts, which are important determinants of an academy's success.
a. Support from the Board of Education and Superintendent: Academies are an integral part of the high school improvement strategy for the district and school choice options. The district Board of Education is aware of the academy and its mission and goals and is on public record in support. Likewise, the Superintendent publicly endorses the academy and offers active support. Both serve as academy liaisons to the broader community and encourage coordination of similar academies across the district.
b. Support from the principal and high school administration: Academies are an integral part of the school improvement strategy. The high school principal and other administrators are knowledgeable about the academy, advocate for it publicly, and are actively involved in its funding, staffing and support. They contribute to a positive academy profile within the high school.
c. Adequate funding, facilities, equipment, and materials: District and high school administrative support results in appropriate academy scheduling, adequate academy funding, facilities, equipment, and learning materials. Support also advances opportunities for student internships, early college and career, and technical training. These reflect a serious commitment from the community, district, and high school to the success of the academy.

Standard 4: Faculty and Staff - Appropriate staff selection, leadership, credentialing, and cooperation are critical to an academy's success.
a. Teacher Leader(s) / Coordinator(s): One teacher (sometimes two) and a dedicated school administrator take the lead, serving as the Academy Coordinators. They attend advisory board meetings, interact with school administrators and board members, manage the budget, help to coordinate teacher professional development, and coordinate employer, higher education, and parental involvement. Release time and / or a stipend may be provided for this role.
b. Academy staff: Academy staff are credentialed in their field, work in the academy, and are committed to its mission and goals. Since a career academy's success rests on good teaching and teamwork among a cross disciplinary group of staff, they must be well qualified and willingly involved in this role. They understand and support the philosophy and purpose of the academy, work together as a team, and teach a majority of their classes in the academy. The academy staff designs instruction and curriculum around a career theme and cooperatively shares the duties of operating the academy.
c. Support from the counselors, non-academy teachers, and classified staff: Counselors are members of the academy team, are well versed in the theme of their dedicated academy and are experts in supporting post-secondary and career opportunities within the academy theme. They understand the need for cohort scheduling and ensure academy students are scheduled appropriately. Non-academy staff are also important to its operation. They understand the value of the academy and help in recruiting students for the academy and providing departmental support. Classified staff help support the academy facilities, equipment, and learning materials.

Standard 5: Professional Development and Continuous Learning - Since an academy places teachers and other adults into roles not normally included in their previous training, providing adequate professional development time, leadership, and support is critical.
a. Common planning time: The site administrator ensures that academy staff are provided common planning time within the high school schedule for purposes of program coordination, curricular integration, business involvement, and resolution of student challenges.
b. Professional development: Experts from outside the high school provide academy staff (administrators, teachers, counselors, media specialists, etc.) with training in the academy structure, project-based learning, performance assessment, curricular integration, student support, and employer involvement.
c. Volunteer and parent orientation: Business, community, and post-secondary volunteers are adequately prepared for their roles as speakers, field experience hosts, mentors, internship supervisors, etc. Parents are adequately prepared for their involvement (if any) as classroom aides, field experience chaperones, social event organizers, and exhibition judges.

Standard 6: Governance and Leadership - The academy has a governing structure that incorporates the explicit roles of all stakeholders and the leaders of the advisory board.
a. Network of support: The academy is connected to an advisory board at the school level or the district level and has members from the district and high school administration, academy staff, employers and post-secondary education. It may also include community representatives, academy parents, and students. The board incorporates viewpoints from all members. All educators participating on the board may or may not be voting members of the board.
b. Regular meetings: Meetings of the advisory board are held at least quarterly, with defined agendas, outcomes and meeting minutes. The advisory board helps to set policies for the academy. It also serves as a center of resource development.
c. A healthy partnership: Both through the advisory board and other interactions there is evidence of a partnership between the academy / high school and its host community that recognizes both employer and school district short and long term needs. Evidence exists that the advisory board is engaged and exhibits as much ownership of the academy as the staff does. There needs to be a set of by-laws or a memorandum of understanding (MOU) that clearly defines all roles.
d. A student voice: Students have avenues through which they can provide input to the academy policies and practices, thus providing opportunities for student leadership such as through Career and Technical Student Organizations (CTSOs).

Standard 7: Teaching and Learning - The teaching and learning within an academy meets or exceeds external standards and college entrance requirements while differing from a comprehensive high school by focusing learning around a theme.
a. External standards: The academic curriculum is framed around the Common Core State Standards (CCSS), national standards, or adopted state standards. The career and college curriculum is framed around national, state, post-secondary, the Common Career Technical Core and / or career readiness standards.
b. Rigorous learning: Coursework reaches high levels of English and mathematics, generally four years of each, in addition to substantial coursework in science and social studies. All graduates are qualified to attend a full range of post-secondary education options without the need for remediation because they have mastered curriculum that meets college entrance requirements.
c. Sequenced, integrated, and relevant curriculum: Curriculum articulates from the beginning of an academy through the senior year, with a defined course sequence and at least two core academic classes and one career / theme class each year. Curriculum is integrated among the academic classes and between these and the career class. Learning illustrates applications of academic subjects outside the classroom, incorporates current technology and $21^{\text {st }}$ Century Skills, and includes authentic project-based learning.
d. Post-secondary planning: Students have access to career and post-secondary information, are provided guidance and advisement in these areas, and begin a written post-graduate plan during their sophomore year, which will be reviewed and refined each semester. The plans begin with goals that each student sets, which become an ongoing personalized learning plan. Progress on this plan is reviewed by the student as well as parents / guardians, counselors, and advisors.
e. Dual credit options: Options for post-secondary credit exist in a variety of ways and may include articulation, dual credit and / or college credit for upper classmen, concurrent credit, trans scripted credit, AP, AICE and IB credit. The academy articulates its upper level curriculum with relevant post-secondary programs.
f. Development of a portfolio and participation in a capstone project: The student portfolio and capstone project are reflective of the academy in which the student is participating.

Standard 8: Employer, Postsecondary Education, and Community Involvement - A career academy links high school to its host community and involves members of the employer, post-secondary education, and civic community in certain aspects of its operation.
a. Local industry / economic needs: The academy career field is selected to align with the economic and workforce development needs of the community and the state. This will ensure that there is adequate preparation of the future workforce and that there are sufficient opportunities for persons currently in this field to be engaged with the academy.
b. Community involvement: Representatives of employers, post-secondary education, and the community help to guide the academy's curriculum, and provide experiential components such as guest speakers, real-world projects, field experience sites, shadowing opportunities, mentors, student internships, community service opportunities, college and other post-secondary education tours, and teacher externships.
c. Citizenship: The academy fosters a culture of respect for others regardless of background and encourages student contributions as global citizens.
d. Work - based learning: The academy offers work - based learning opportunities for all interested students either through internships, community service, or other community-based work programs that the advisory board and the school district planning team determine are the best approach for that academy and community.

Standard 9: Student Assessment - Improvements in student performance are central to an academy's mission. It is important to gather data that reflect whether students are showing improvement and to report these accurately and fairly to maintain the academy's integrity.
a. Student data: Student data include those necessary to describe the student body within the academy (e.g., grade level, gender, race / ethnicity) and its relationship to the high school in general, as well as student performance on a variety of outcome measures. b. Multiple academic measures: Measures include a variety of accepted indicators of performance (e.g., attendance, retention, credits, grade point averages, state test scores, graduation rates, college going rates) as well as rubric-based assessments on performance tasks. Multiple measures need to be aligned to Common Core State Standards (CCSS), and longitudinal data are collected.
c. Technical learning: Measures include knowledge of the field's terminology, technical concepts, and ability to apply academic skills to authentic real world projects. Where appropriate, industry recognized credentials, certifications, or licenses are incorporated.
d. Accurate reporting: Analysis of the data elements is reported accurately and fairly regardless of the results.
e. Evidence of impact: These measures show whether, and how much, the academy improves student performance. Teacher teams use student assessment to evaluate the quality of the education provided in the career academy and to make improvements to curriculum, instruction, and program structures. A longitudinal study shows whether
there are improved student outcomes in terms of reduced dropouts, increased academic success, career readiness preparation and greater entry into post-secondary education.

Standard 10: Sustainability - No new academy functions perfectly. Even well established and highly functioning academies benefit from self-examination and refinement. Ensuring and improving the quality of a career academy requires engaging in a regular cycle of improvement.
a. Academy implementation: Program leaders regularly assess the academy's functioning, studying its strengths and weaknesses. This involves gathering feedback from key stakeholders, including students.
b. Academy refinements: All stakeholders, including students, are surveyed regularly and input considered. These reviews lead to plans to address any problems. Such plans include timetables and benchmarks for improvement.
c. Reflection of the academy's mission and goals: The refinements refer back to the academy's underlying mission and goals and are supported by data, evidence and / or survey results.

## NAF Distinguished Academy Evaluation Criteria

## Thresholds

- Open enrollment
- 50 or more students per grade
- Fully implemented program with at least 4 NAF courses and one graduating class
- Acquired the necessary human, financial, and technical resources needed to support the academy
- Integration of NAF courses into at least 5 core classes
- Fully implemented work-based learning program


## Characteristics

- Established student recruitment and orientation program
- Committed principal
- $\quad$ Strong academy leadership
- High academic expectations
- Use of data to measure and improve performance
- Consistent messaging on college attendance and career options
- Dedicated guidance counselor(s)


## Where Quality Grows

In analyzing data of those academies that have increased in quality as measured by NAF's Academy Assessment, there are several areas of focus that have led to the most improvement.

- Increasing support to strengthen recruitment, course integration, and academy leadership
- Increasing capacity across the academy team
- Engaging the advisory board in the Academy Assessment process so that they understand the expectations for successful advisory board involvement
- Increasing proportionate representation of the business and higher education communities on the advisory board
- Aligning academy growth to district initiatives
- Increasing the number of business partners participating on the advisory board
- Establishing additional partnerships to increase internship opportunities
- Strengthening recruitment strategies to increase enrollment in the academy
- Collaborating to effectively integrate career themes across core subject areas


## APPENDIX G

## Student Permission Slip - First Two Years of Data Collection

Modified Student Permission Slip - Third Year of Data Collection

## Student Release Form

(to be completed either by the parents/legal guardians of minor students involved in this research project)

## Dear Parent / Guardian,

I am a Candidate for the Ph.D. in Aviation with Embry-Riddle Aeronautical University, working on my dissertation to complete my program for the degree. My dissertation is a study of the organizational design of successful aviation / aerospace career academies or career-themed programs. I am collecting data via an online survey for analysis in my dissertation. All individuals associated with your student's successful career academy (students, career education teachers, core academic teachers for cohorted students, school and district administrators and resource teachers, school staff, advisory board members, parents, and alumni) are invited to participate by taking the survey.

Before your student can take the online survey, he / she must obtain your signature on this Release Form. The data collected through the survey does not require your student to provide any personal identification information. There is a demographic information page that asks general questions at the end of the survey. Participants (including your student) can add comments after any of the survey items. If these comments could provide information that would identify your student, those identifiers will be kept confidential by the researcher on a private external hard drive that is unavailable to the public.

The data analysis and results of the study may be used in articles that will be submitted for publication and for presentations at academic and professional conferences, but information specific to individual participants will not be included in these articles or presentations.

If you agree to your student's participation through taking the online survey, and the researcher's right to use the data collected for the dissertation study, as well as subsequent articles and presentations, please sign the Release Form. The form will be retained with other documentation for the dissertation. Upon turning in the signed Release Form, your student will be given a card containing the access URL for the online survey. $\mathrm{He} /$ she may take the survey when it is convenient; the survey takes about 10 minutes to complete. If you are interested in taking the survey, please check the box to indicate this information and provide an email address so I can send you the URL hyperlink in an email. Thank you very much.

Sincerely,

Susan K. Archer, Ed.D.
Primary Researcher

## Student Release Form Permission Slip

Student Name: $\qquad$
Student Email: $\qquad$
School / Teacher: $\qquad$
Your Address: $\qquad$

I am the parent / legal guardian of the student named above. I have received and read your letter regarding your dissertation research and the survey being conducted to collect the data for the research project. I agree to the following:
$\square$ I DO give permission to Susan K. Archer to collect data from my student, via an online survey. I understand that my student will receive a card containing the URL code for the survey, once he/she returns this signed permission slip.
$\square$ I DO NOT give permission to Susan K. Archer to collect data from my student
for her dissertation research project.

## Signature of Parent/Guardian:

$\qquad$
Date: $\qquad$
$\square$
I am interested in participating in the survey. Please send me an email with the URL hyperlink to the online survey, to the following email address:

Parent Email: $\qquad$

Parental Consent Form<br>Embry-Riddle Aeronautical University IRB. February 2018

Agreement To Participate in
Structural Equation Modeling of Successful Secondary Aviation/Aerospace/Engineering Education Program Organizational Design Survey

STUDY LEADERSHIP. We are asking you and your child to take part in a research project that is led by Susan K. Archer, PhD candidate and David Esser, professor of aviation at Embry-Riddle Aeronautical University.

SPONSORSHIP. This study is being paid for by the PhD candidate.
PURPOSE. The purpose of this study is to determine relationships between organizational design factors and success of pre-college aviation, aerospace, and engineering programs. The results could be used to improve existing programs that are struggling and to implement new programs, improving STEM opportunities for more students.

ELIGIBILITY. To be in this study, your child must be 14 to 17 years old and must be participating or have participated in a school-based or community-based career education program in aviation, aerospace, or engineering (including robotics or coding).

PARTICIPATION. Upon your consent, your child will be provided the URL code to access an online survey via Surveymonkey.com. He/she can access this survey from any internet-capable device (computer, tablet, cell phone). There are 35 survey items in the form of opinion statements about the program in which your child is involved, with five response choices from "strongly agree" to "strongly disagree." Each of these items also offers your child a space for additional comments, if he/she wants to add to the initial response. At the end of the survey there are general demographic items as well (i.e., Gender, Race / Ethnicity, Grade Level, Grade Point Average).

RISKS OF PARTICIPATION. The risks that your child run by taking part in this study are minimal. Participation in the survey is completely voluntary and designed to be anonymous. Additionally, your child may choose to exit the survey without completing it at any time. At no point in the survey is your child asked to provide his/her name or a method by which he/she can be reached for further communication. If your child chooses to add comments to one or more Likert scale responses, it is possible that he/she could provide information that identifies a school, a district, or an individual associated with a particular program. This information (combined with demographic information) could lead to identification of your child by other stakeholders for that specific program. For this reason, if his/her comments are included in the narrative for data analysis or conclusions to this study, all names of individuals, schools, districts or geographic information included in the comments will be excluded from the narrative. Only the researcher will have access to the comments made by your child, and this information will be secured by the researcher for five years, whereupon it will be destroyed. There is a minimal risk that the demographic information we collect about your child may become
known to outsiders through computer hacking into secure computer files or accidental exposure of these files. These risks are similar to that for any personal information that may be transmitted or hacked through the internet or physically stolen.

BENEFITS OF PARTICIPATION. The study may or may not benefit you or your child personally. The benefit to participation is the understanding that your child's opinions are valuable to the academic communities for education and organizational theory. Students in educational programs are not always involved in the analysis of the programs in which they participate, so involving them in a study of career education will be valuable in furthering the career and technical education movement.

COMPENSATION. No financial compensation will be offered to you, your child, or their school or community program. However, the researcher will offer the use of the survey and her expertise should a school district, community program, or individual school wish to apply this methodology to evaluate other educational programs.

VOLUNTARY PARTICIPATION. Your child's participation in this survey is completely voluntary. He/she may stop or withdraw from the survey at any or refuse to respond to any particular survey item for any reason, without it being held against him/her.

CONFIDENTIALITY. Your child's privacy and confidentiality will be protected in all papers, reports, talks, posts, or stories resulting from this study (the survey is designed for anonymity, but should your child identify himself/herself, that identity will not be released). We may share the statistical data we collect with other researchers, but we will not reveal your child's identity with it. In order to protect the confidentiality of his/her responses, we will separate any personal identifying information from all other information we collect, in which we will identify his/her data only by an assigned code number. The Surveymonkey.com site is a well-known and respected site for collecting survey response data. All project information will be stored on password- and firewallprotected computers, or in locked filing cabinets behind locked doors. We will destroy all the identifying information we have about your child, within five years of completion of the study, keeping only anonymous, numerically coded data files that will be used only for research purposes.

FURTHER INFORMATION. If you have any questions or would like additional information about this study, please contact Susan K. Archer at 904-655-1325. The university's ethics committee, also called the IRB, has approved this project. You may contact the IRB with any questions about research ethics, risks, or benefits at 386-2267179 or at teri.gabriel@erau.edu. The IRB website is https://erau.edu/research. A copy of this form will be given to you if you wish to keep it.

CONSENT. Your signature below means that you understand the information on this form, that someone has answered any and all questions you may have about the Structural Equation Modeling of Successful Secondary Aviation/Aerospace/Engineering

Education Program Organizational Design Survey, and you voluntarily agree to participate in it.

Parents/guardians are also welcome to participate in the study. If you are interested in taking the survey, please check the box below and provide your email address. You will receive an email with the URL access code for the survey, from the researcher (archers2@erau.edu). Your email address will be kept secure by the researcher in the same manner described above for the survey response data.

Name of Participating Child

I AM interested in participating in the study, and wish to have the URL access code sent to my email:
(email - please print legibly) $\qquad$


I AM NOT interested in participating in the study.

Signature of Parent or Guardian Date

Print Name of Parent or Guardian

Signature of Researcher ris runt sich Date $2 / 1 / 2018$

Print Name of Researcher Susan K. Archer
Structural Equation Modeling of Successful Secondary Aviation/Aerospace/Engineering Education Program Organizational Design Survey Embry-Riddle Aeronautical University

## APENDIX H

Revised Factors and Associated Survey Items

## Factor 1.

Q6: There is a system in place to measure my academy's progress according to our vision statement. (original construct - vision)

Q8: Leaders (students and / or adults) help everyone work to achieve the goals and objectives of my academy. (original construct - leadership)

Q9: Leaders (students and / or adults) regularly interact with members of my academy to involve us in planning and decisions. (original construct - leadership)

Q10: Everyone involved with my academy (students and / or adults) is expected to contribute to the academy's success. (original construct - leadership)

Q11: When someone involved with my academy (students and / or adults) does not meet their responsibilities, they know they will be held accountable. (original construct leadership)

Q13: Important information about my academy is communicated to everyone in a timely manner. (original construct - communication)

Q17: We use teamwork to get work done in my academy. (original construct teamwork)

Q19: Everyone involved with my academy (students and / or adults) is able to have input about what we do and the direction we are going. (original construct - teamwork) Q27: Everyone (students and / or adults) in my academy is involved in lifelong learning to increase their related skills, knowledge, or talents. (original construct - learning) Q32: I believe everyone involved with my academy (students and / or adults) plays a part in making my academy better (with respect to the vision statement, goals, and objectives). (original construct - flexibility)

## Factor 2:

Q1: I believe that I can be successful as a participant in and / or contributor to my academy. (original construct - motivation)

Q2: I believe my effort / participation level with respect to my academy directly affects how well I achieve my expectations. (original construct - motivation)

Q3: I believe that participating in and / or contributing to my academy is a valuable experience (with respect to my personal goals). (original construct - motivation) Q4: Decisions about my academy are aligned with the vision statement. (original construct - vision)

Q7: The things I participate in that are related to my academy seem to be aligned with the vision statement. (original construct - vision)

Q26: My academy provides opportunities for me to improve my related skills, knowledge, or talents, if I want to participate. (original construct - learning)

Q30: My academy is flexible enough to adapt to change in related industries or academic requirements. (original construct - flexibility)

Q31: I believe my academy gets better (with respect to the vision statement, goals, and objectives) every year. (original construct - flexibility)

## Factor 3:

Q5R: Daily activities / processes within my academy are not aligned with the vision statement. (original construct - vision)

Q16R: The way information is presented for my academy makes it difficult to understand. (original construct - communication)

Q20R: In my academy we have power struggles that affect how well we achieve our goals and objectives. (original construct - teamwork)

Q24R: Resources are not always used for activities that align with the academy vision. (original construct - resources)

Q25R: It is difficult to determine who makes decisions about how to use resources for my academy. (original construct - resources)

Q28R: My academy does not provide a support system for helping participants meet their responsibilities. (original construct - learning)

Q29R: I believe I can learn more career-related knowledge associated with my academy outside the academy than by participating within it. (original construct - learning) Factor 4:

Q21: We have the supplies and material resources we need to meet the goals and objectives of my academy. (original construct - resources)

Q22: We have the technology and equipment resources we need to meet the goals and objectives of my academy. (original construct - resources)

Q23: We have the people (students and / or adults) we need to meet the goals and objectives of my academy. (original construct - resources)

