UNDERSTANDING WORKFORCE AGILITY AT NASA KENNEDY SPACE CENTER

by

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A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the Department of Industrial Engineering and Management Systems
in the College of Engineering and Computer Science
at the University of Central Florida
Orlando, Florida

Fall Term
2023

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ABSTRACT

NASA leads the world in space research and provides other government agencies, educational institutions, and companies opportunities to explore, launch, and conduct research in and around space. NASA has 11 formal locations based around the United States, and each has different goals and objectives to help NASA meet its overall mission. 2004, President George Bush announced a new vision for the Space Exploration program. During his grand announcement, he discussed that the Space Shuttles would retire due to the 2003 Space Shuttle Columbia accident, where the crew and the space vehicle were lost. The Kennedy Space Center (KSC) would no longer manage the day-to-day operations of maintaining the US Space Shuttle fleet. Our NASA teams would continue working to finish the Space Shuttle program's mission to build the International Space Station. Afterward, NASA would transition to develop and test a new spacecraft, the Crew Exploration Vehicle. The third goal was to return to the moon by 2020 as the launching point for missions beyond, to get humans from lower Earth orbit to the moon and Mars. (Secretary, 2004) The KSC engineering workforce had to prepare to transition from Operational support of the Space Shuttle program to the design and development of over 50 subsystems for the future SLS and Orion Launch Systems at the Kennedy Space Center. These subsystems developed at the Kennedy Space Center Engineering Directorate followed a comprehensive design process that required several different product deliverables during various phases for each subsystem. (Schafer et al., 2013) What allowed these systems to be successful? What enabled NASA KSC to complete over 130 Artemis 1 Design Certification and System Acceptance Reviews, closing over 21,656 Requirements to deem the Artemis 1 rocket ready for launch? Little is known about the NASA engineering workforce agility characteristics that enabled the organization to transition from the Space Shuttle program that ended in 2011 and launch the Artemis Program's SLS rocket on November 16, 2022.

This study is dedicated to my mother, Marie Rose Paul-Herisca,
who started this journey with me in the Fall of 2017 but passed away in March of 2022.
Thank you, Mom, for your many sacrifices to ensure I had a quality education.
Thank you for supporting me and teaching me to value God, family, and education.
The sacrifices you made to leave the island of Haiti for a better life have enabled me
to be the woman I am today. I miss you and love you!

ACKNOWLEDGMENTS

First, I would like to thank my Lord and Savior, Jesus Christ, for all his great blessings and for giving me the wisdom, grace, and knowledge to complete this degree.

I want to thank my advisor, Dr. Waldemar Karwowski, for guiding me through this process and always being supportive. You have been an exceptional advisor, and I am thankful for all your feedback, wisdom shared, and encouragement to get me to the finish line. I would like to thank Mrs. Liz Stalvey; from day one, you have been a blessing to me. Thanks for pointing me in the right direction and recommending my adviser for this degree; you did not steer me wrong.

I would like to thank my doctoral committee, Dr. Timothy Kotnour, Dr. Luis Rabelo, and Dr. Piotr Mikusinski, thank you for your time, expertise, and willingness to serve on this committee.

I thank my husband, Melvin Vazquez, for his unconditional love and support. Thank you for being my sounding board when times were good or rough and for willingly taking care of the kids so I could study and work on assignments. Thanks for being the MVP of our home during this journey! I want to thank my sons, Christian and Zion, for allowing mommy to do homework, for being my reminder and my "WHY." May this encourage you in your pursuits in life to press past all obstacles and become everything God purposed you to be.

To my father, Mr. Ledan Herisca, in memory of my mother, Marie Rose Paul-Herisca, thank you for your love, sacrifices, and support. I am thankful that you were great parents and did your very best.

To my NASA KSC Family, specifically the KSC Engineering (NE) Directorate Management and Colleagues, the NASA Kennedy Graduate Fellowship Program (KGFP) Program and George Snow Scholarship Foundation, all my mentors, family, and friends; thank you for believing in me and for your support and encouragement thru this journey.

May the Lord richly bless each of you is my prayer.

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LIST OF ACRONYMS/ABBREVIATIONS

EGS	Exploration Ground System
IRB	Institutional Review Board
IT	Information Technology
KSC	Kennedy Space Center
NASA	National Aeronautics and Space Administration
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SEM	Structural equation modeling
SLS	Space Launch System
STS-135	Space Transportation System -135
UCF	University of Central Florida

CHAPTER ONE: INTRODUCTION

1.1 Background

NASA needs no formal introduction. Whenever the acronym is uttered, people automatically know that you refer to the National Aeronautics and Space Administration (NASA) and its famous blue meatball with white letters. NASA leads the world in space research and provides opportunities to other government agencies, educational institutions, and companies to explore space, launch into space, and conduct research in and around space. NASA has 11 formal locations based around the United States, and each has different goals and objectives to help NASA meet its overall mission.

This paper will focus on the launch and operational capabilities at the Kennedy Space Center. I was hired into the Kennedy Space Center in August of 2004 after graduating from the University of Central Florida with a bachelor's degree in electrical engineering. Upon entering the KSC workforce, I noticed several different generations of people working on the Space Shuttle program. I was hired as an engineer to support the Space Shuttle program. I quickly observed that I worked within a multi-generation company with engineers who had experience supporting the Mercury, Gemini, and Apollo programs.

Before joining the Kennedy Space Center (KSC) team, President George Bush announced that the Space Shuttles would retire due to the 2003 Space Shuttle Columbia accident, where both the crew and the space vehicle were lost. Moreover, a new program, the "Constellation" program, would be created to take its place. KSC would no longer manage the day-to-day operations of maintaining the US Space Shuttle fleet. Our teams would finish the Space Shuttle program's mission to complete the International Space Station. Afterward, the KSC workforce would transition to design the new SLS rocket to get humans from lower Earth orbit to the moon and Mars. (Secretary, 2004)

This dissertation aims to define workforce agility via a literature review and then conduct a research survey of the KSC Engineering workforce to determine the agility of our KSC workforce during the transition from the Space Shuttle Program to the new Exploration Ground System (EGS) program.

1.2 Statement of the Problem

The KSC engineering workforce had to prepare to transition from Operational support of the Space Shuttle program to the design and development of over 50 subsystems for the future SLS and Orion Launch Systems at the Kennedy Space Center. These subsystems developed within the Kennedy Space Center Engineering Directorate followed a comprehensive design process that required several different product deliverables during various phases for each subsystem (Schafer et al., 2013). What allowed these systems to be successful? What enabled NASA KSC to complete over 100 Artemis 1 Design Certification and System Acceptance Reviews, closing over 20,000 Chief Engineer Board Requirements to deem the Artemis 1 rocket ready for launch?

Little is known about the NASA engineering workforce agility characteristics that enabled the organization to transition from the Space Shuttle program that ended in 2011 and launch the Artemis Program's SLS rocket on November 16, 2022.

This dissertation will attempt to determine the agility of the NASA KSC Engineering workforce via a research survey. Utilizing the characteristics of an agile workforce as defined per the literature review, a survey will be conducted. The survey results will then provide data to NASA KSC on ways to improve the workforce agility or give pointers to other organizations on NASA's agility characteristics that have allowed the NASA KSC Engineering workforce to be agile.

1.3 Research Gap

During the literature review phase, it was discovered that there is a lack of comprehensive studies that analyze workforce agility within the aerospace industry. The articles found during the literature review process were from non-aerospace industries. This identifies a gap in research conducted in the aerospace industry. This dissertation will aim to study NASA KSC and provide data on the agility characteristics at NASA KSC, a US government agency leading research within aeronautics.

1.4 Research Objectives

The primary objective of this research is to determine the agility of the NASA KSC Engineering workforce since the transition from the Space Shuttle program to the EGS, better known as the Artemis Program. A secondary goal is to develop a list of critical agile characteristics utilized at NASA so that other aerospace companies can benefit from the data. Finally, the findings from this research will advance the knowledge in defining how organizations can become more agile or incorporate agile processes to respond better to the market.

Chapter 2 will comprehensively review agility by defining various agility characteristics. Subsequently, chapter 3 discusses this dissertation's research hypotheses, model, and methodology. A survey will be conducted with the NASA KSC Engineering workforce to validate the assumptions. In Chapter 4, we will provide the results of the survey research study. In Chapter 5, we will have a discussion and conclude.

CHAPTER TWO: LITERATURE REVIEW

2.1 Evaluation of Review Papers

There is a lack of articles available regarding workforce agility within the aerospace industry. My search had to be modified to capture workforce agility journal articles and literature reviews published between 2015 and the present in Table 1.

Table 1: Workforce agility Literature reviews published between 2015 until 2020

Area of Application	Database	Returned Journal Articles	Range of Dates
workforce agility aerospace	ProQuest ABI	50	2015 - 2021
agile workforce aerospace	ProQuest ABI	50	2015 - 2021
agility survey aerospace workforce	ProQuest ABI	31	2015 - 2021
agility questionnaire aerospace workforce	ProQuest ABI	13	2015 - 2021
agility assessment aerospace workforce	ProQuest ABI	29	2015 - 2021
agile workforce evaluation aerospace	ProQuest ABI	30	2015 - 2021
agile workforce survey aerospace	ProQuest ABI	29	2015 - 2021
agile workforce questionnaire aerospace	ProQuest ABI	16	2015 - 2021
agile workforce assessment aerospace	ProQuest ABI	33	2015 - 2021
agile leadership aerospace	ProQuest ABI	50	2015 - 2021
agile culture aerospace	ProQuest ABI	50	2015 - 2021
agile paradigm aerospace	ProQuest ABI	85	2015 - 2021
workforce agility	ProQuest ABI	1107	2015 - 2021
workforce agility and aerospace	Engineering Village	0	2015 - 2021
agile workforce AND (aerospace)	Engineering Village	0	2015 - 2021
agility survey AND (aerospace)	Engineering Village	0	2015 - 2021
agility questionnaire AND (aerospace)	Engineering Village	0	2015 - 2021
agility assessment AND (aerospace)	Engineering Village	0	2015 - 2021
agile workforce evaluation aerospace	Engineering Village	0	2015 - 2021
agile workforce survey aerospace	Engineering Village	0	2015 - 2021
agile workforce questionnaire aerospace	Engineering Village	0	2015 - 2021
agile workforce assessment aerospace	Engineering Village	0	2015 - 2021
workforce agility	Engineering Village	40	2015 - 2021

This literature review will perform a systematic review utilizing PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to define and further understand "Agility." This literature review will enable a thorough method to conduct and analyze survey data to determine the agility within an organization.

PRISMA has created a checklist of 27 pointers to consider when reporting a systematic review. According to (Liberati et al., 2009), "A systematic review attempts to collate all empirical evidence that fits pre-specified eligibility criteria to answer a specific research question. It uses explicit, systematic methods that are selected to minimize bias, thus providing reliable findings from which conclusions can be drawn and decisions made." Utilizing the PRISMA guidelines to create and document a systematic review is critical to ensure accuracy and good data gathering.

Of the 1631 articles received from the various portals, twenty-six papers were selected and will be used during the literature review. None of the papers selected used the systematic literature review method. The papers selected provided various methods from survey questionnaires or research to define an agile workforce or workforce agility. The average and median numbers of included articles among these reviews were 47 and 60, respectively. More specifically, the maximum number of papers used in the published studies was 123 (Menon & Suresh, 2021), while the minimum was 10 (Suofi et al., 2014).

To write this literature review, the UCF library services were utilized. The conduct the web searches, the keywords contained several agility terms and included different survey research methods as the primary search criteria. To understand how to use surveys for research, interpret and document future evidence. The terms searched in the databases are listed in Table 2.

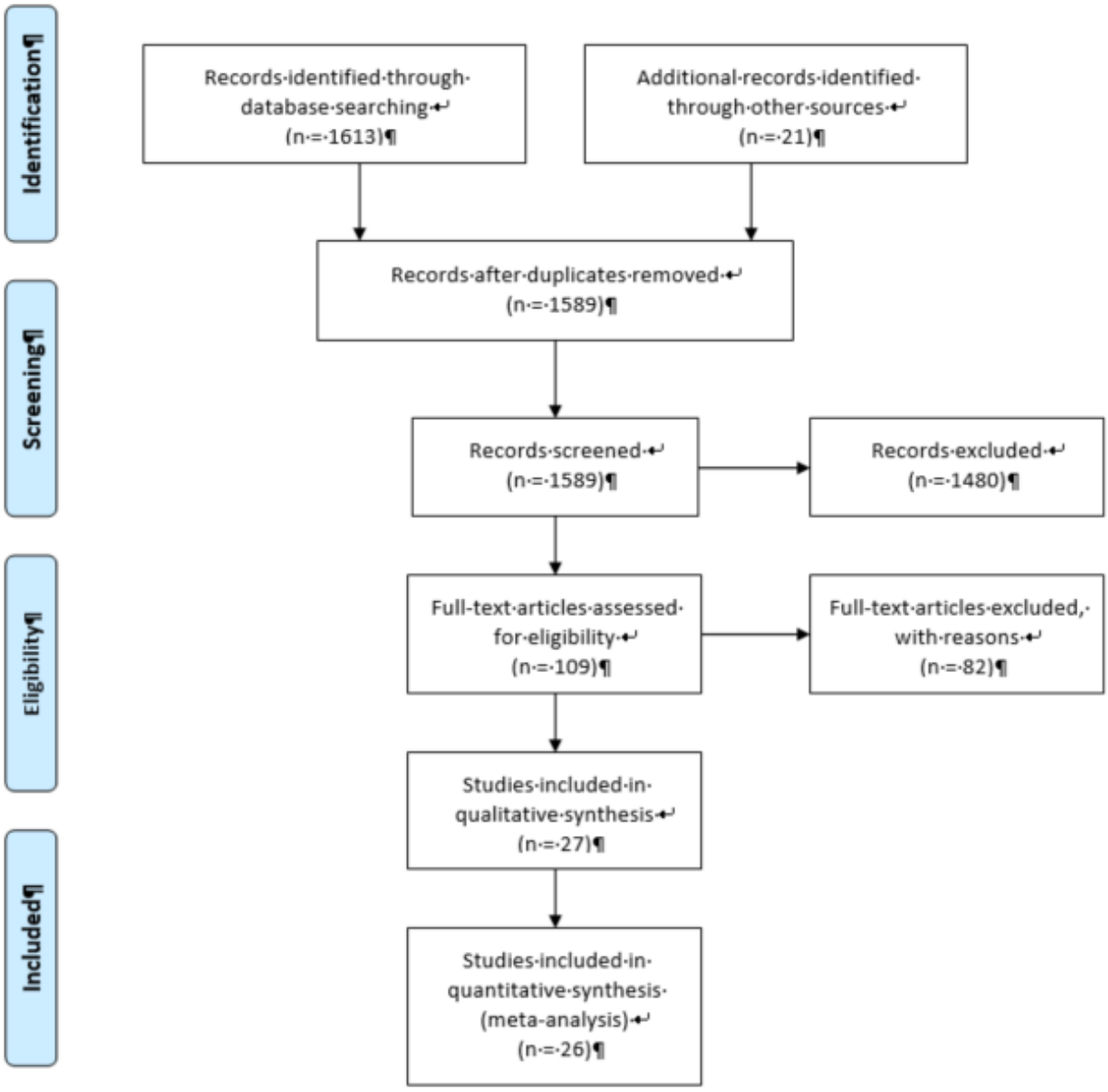
Table 2: Agility Terms Searched

Agile workforce evaluation aerospace	agile workforce assessment aerospace	workforce agility
Agile workforce survey aerospace	agile leadership aerospace	Agile workforce questionnaire aerospace
Agile workforce questionnaire aerospace	agile culture aerospace	agile paradigm aerospace

These terms were searched on the tools and subscriptions provided by the UCF Library, such as Compendex (EI Engineering Village), EBSCOhost (Applied Science & Technology, Academic Search Premier, Business Source Premier), IEEE Xplore, ProQuest (ABI/INFORM Complete: Dateline, Global, Trade & Industry) and Google Scholar. During the search, a list of 1,613 journal articles, conference articles, reports, and literature reviews were returned. The list was scrubbed to identify and remove all duplicate articles and articles that did not fit the criteria for this literature review. To capture the word "Agility," both "Agility" and "Agile" were searched to capture targeted articles. The list was then narrowed down to 26 Journal Articles that will support this literature review. ProQuest ABI and Engineering Village provided the most selected review papers for this Literature review, utilizing the search term workforce agility.

While reviewing and analyzing articles to better understand agility, many papers were disqualified because they did not break down agility or discuss how it was measured. PRISMA's four-phase Systematic Review Process assisted in identifying which articles explained agility and defined the characteristics of an agile workforce, see Table 3. The articles were further screened to determine which papers were relevant for this literature review and provided the level of detail needed for this literature review.

Table 3: PRISMA 4-Phase Systematic Review Process



2.2 What is Agility?

So, what is agility? According to Muduli, "Agility is an enterprise-wide strategy for responding to a competitive and changing business environment. Developed in the 1950s in the field of air combat, agility was defined as "an aircraft's ability to change maneuver state, or, put another way, as the time derivative of maneuverability" (Richards, 1996). The agility concept was popularized in manufacturing in the early 1990s. It was soon extended to the broader business context, where it has been defined as an organization-wide capability to respond rapidly to market changes and to cope flexibly with unexpected change to survive unprecedented threats from the business environment (Huang & Nof, 1999)." (Muduli, 2013)

According to (R. Qin & D. A. Nembhard, 2015), "Workforce agility is the management of labor and personnel capacity and capability for organizations facing unpredictable change is a complex and diffuse area." (Suofi et al., 2014) 2014 further explain, "Workforce agility is the strategy, which helps profitability in rapidly changing, and uncertain production environments."

With those changes, the organization's workforce delivers Steller performance and leads the market as a specialist in that industry. Ultimately achieving the goals of that company or organization without any interruptions. For this paper, the definition that related most to the aerospace industry is the definition provided by (Aburub, 2015), "Agility can be defined as the ability of an organization to adapt to unexpected and uncertain situations and changes in the environment."

During this literature review, the focus is to define the traits and characteristics that the workforce must possess to be considered an agile workforce, realizing that some organizations have these traits and are unaware that they are agile.

2.3 Characteristics of Workforce Agility

To understand more about agility and workforce agility, the main questions that surface are which characteristics define an agile workforce and what features an agile organization possesses. Besides, how do we measure these characteristics to state that an organization has an agile workforce or a non-agile workforce? Similarly, what are the benefits of an agile workforce versus a non-agile workforce?

(Suofi et al., 2014) identified the characteristics of workforce agility as a workforce that possessed flexibility, responsiveness, speed, the culture of change, integration and low complexity, high quality and customized products, and mobilization of core competencies. (Koçu, 2018) defined the characteristics of workforce agility as responsiveness, competency, flexibility, and quickness. (R. Qin & D. A. Nembhard, 2015), "Identified the characteristics of workforce agility as responsiveness, quickness, competence, adaptability, and cooperativeness." Since these papers identified these characteristics as the main drivers of workforce agility, they also focused their survey questions on their respective workforce members around those characteristics.

For the literature review, the articles reviewed pertained to agility in manufacturing industries, and no results were available for agility in the aerospace industries. Therefore, this review will define agility according to these organizations to develop a list of agile characteristics. That information will be used to describe workforce agility within the aerospace industry.

What are the various characteristics of an agile organization, and how can they be summarized into a list of key traits that can be studied to determine an organization's workforce agility? In reviewing the 26 papers screened and used for this literature review, 49 characteristics were discovered that define an agile workforce. These characteristics were used to describe workforce agility in various industries and companies. The papers reviewed studied workforce agility within an educational institution, an Emergency Center, a Petroleum Management firm, Western-Romanian companies, Telecom Industries, the banking sector, Information Technology Company in India, an Iranian Technology company, Iranian

SMEs, a food company, a park, law firm, small manufacturing enterprise, healthcare industry, operations management, and software development teams.

The organizations that generated these characteristics are not aerospace companies but share a core company characteristic with aerospace companies. All these industries have workforces and aim to have an agile workforce. Moreover, all these industries desire to create workforce agility within their organizations. Hence, their "organizations can adapt to unexpected and uncertain situations and environmental changes (Aburub, 2015) while continuing their companies' success.

In the various papers, agility characteristics have been referred to as agility attributes, capabilities, drivers, or even enablers of agility. This paper will refer to these descriptions of agility as characteristics. So, what are the various characteristics companies use to define workforce agility? Table 4 lists the agile characteristics identified per this literature review. Forty-nine features are identified per the various journal and conference articles to define workforce agility. These characteristics describe workforce agility in multiple companies, industries, and institutions.

Table 4: Agile Characteristics per Literature Review

Journal Authors										
Agility Characteristics	Aburub	Akkaya & Tabak	Alavi	Alavi, Wahab, Muhamad & Shirani	Aidan, Alibabaei, Mohammad	Braun et Al.	Dattero, Galup, Kan & Quan	Dubey & Gunasekaran (2014)	Goodarzi, Shakeri, Ghaniyoun & Heidari	Gyemang & Emeagwali
Competence	X	X								
Flexibility	X	X				x		X		
Responsiveness	X	X					x			
Adaptability			X	X		x				
Team Building/Teamwork							x			
Collaboration/Networking						x	x			
Knowledge Sharing/Informative							x		X	X
Training & Development										
Technology								X	X	
Empowerment								X	X	
Organizational Culture of Change						X		X		
Incentives, Rewards & Recognition										
Speed		X								
Quickness	X									
Proactivity			X	X		x				
Resilience			X	X		X				
Employee Involvement						x				
Information Systems										
Learning & Innovation										
Integration & Low Complexity										
High Quality										
Commitment					X					
Staffing						x				
Management Support										
Communication										
Psychological Empowerment										
Employer Brand					X					
Customized Products										
Mobilization										
Cooperativeness										
Change										
Partnership										
Market										
Education										
Welfare										
New Capability										
Roles										
Autonomy										
Emotional Intelligence										
Job Satisfaction					X					
Coordination										
Intelligence & Knowledge									X	
Meaning										
Impact										
Self Determination										
Supllier Relationship								X		
Customer Focus								X		
Sustainability										
Dynamic Capabilities										X

Table 5: Agile Characteristics per Literature Review

Journal Authors										
Agility Characteristics	Jones	Koçu	Kusuma, Lal & Richter	Menon & Suresh	Muduli (2013)	Muduli (2016a)	Muduli (2017)	Muduli & Pandya (2018)	Munteanu, Bibu, Nastase, Cristache & Matis	Nejatian, Zarei, Nejati & Zanjirchi
Competence		X	X		X			X		X
Flexibility		X			X					
Responsiveness		X	x							
Adaptability										
Team Building/Teamwork			x		X	X	X			X
Collaboration/Networking	x			X	X				X	
Knowledge Sharing/Informative			X	X	X					
Training & Development				X	X	X	X		X	
Technology				X						X
Empowerment				X	X				X	
Organizational Culture of Change	X		X							
Incentives, Rewards & Recognition				X		X	X		X	
Speed			x		X					
Quickness		X			X					
Proactivity										
Resilience										
Employee Involvement				X		X	X			
Information Systems					X	X	X			
Learning & Innovation	x		x	X						
Integration & Low Complexity										X
High Quality										X
Commitment				X						
Staffing									X	
Management Support				X						
Communication	x			X						
Psychological Empowerment				X				X		
Employer Brand							X			
Customized Products										
Mobilization										
Cooperativeness										
Change										X
Partnership										X
Market										X
Education										X
Welfare										X
New Capability				X						
Roles				X						
Autonomy				X						
Emotional Intelligence				X						
Job Satisfaction										
Coordination									X	
Intelligence & Knowledge										
Meaning								X		
Impact								X		
Self Determination								X		
Supllier Relationship										
Customer Focus										
Sustainability	X									
Dynamic Capabilities										

Table 6: Agile Characteristics per Literature Review

Journal Authors					
Agility Characteristics	Qin & Nembhard	Sherehiy & Karwowski (2014)	Suofi, Hosnavi & Mirsepasi	Suresh & Patri	Tripathi, Srivastava & Sankaran
Competence	X			X	
Flexibility			X	x	
Responsiveness	X		X		
Adaptability	X	X		x	
Team Building/Teamwork					
Collaboration/Networking					
Knowledge Sharing/Informative					
Training & Development					
Technology				X	
Empowerment					
Organizational Culture of Change			X		
Incentives, Rewards & Recognition					
Speed			X		
Quickness	X				
Proactivity		X			
Resilience		X			
Employee Involvement					
Information Systems					
Learning & Innovation					
Integration & Low Complexity			X		
High Quality			X		
Commitment					
Staffing					
Management Support				X	
Communication					
Psychological Empowerment					
Employer Brand					
Customized Products			X		
Mobilization			X		
Cooperativeness	X				
Change					
Partnership					
Market					
Education					
Welfare					
New Capability					
Roles					
Autonomy					
Emotional Intelligence					
Job Satisfaction					
Coordination					
Intelligence & Knowledge					
Meaning					
Impact					
Self Determination					
Supllier Relationship					
Customer Focus					
Sustainability					
Dynamic Capabilities					

Since the list of workforce agility characteristics was more significant than expected, to define agility for this paper, we will discuss the terms that appeared the most within the articles used to define workforce agility. Table 4, Table 5, and Table 6: provides a list of the Agile characteristics captured during the Literature Review Process. Then the Workforce agility characteristics were ranked, according to the number of papers they appeared in for the literature review in Table 7.

Table 7: Ranked Workforce Agility Characteristics

Ranked Agility Characteristics	Total
Competence	9
Flexibility	8
Responsiveness	7
Adaptability	6
Team Building/Teamwork	6
Collaboration/Networking	6
Knowledge Sharing/Informative	6
Training & Development	5
Technology	5
Empowerment	5
Organizational Culture of Change	5
Incentives, Rewards & Recognition	4
Speed	4
Quickness	4
Proactivity	4
Resilience	4
Employee Involvement	4

The top 17 workforce agility characteristics are listed in Table 7 , and the rest of the characteristics, which appeared in Table 4, Table 5, or Table 6, were only captured in one, two, or three of the articles. Therefore, this literature review will not further discuss those features that occurred less than four times. The following sections will define the top 17 characteristics of workforce agility discovered per the literature. It can be understood why these characteristics are essential and represent an agile workforce.

2.3.1 Competence

Being competitive is achievable when we are confident in our abilities and our organizations invest the resources towards our continued learning. Continued education enables a workforce to be competent and willing to take on new challenges when the company embraces a new direction. Competence enables us to be open to learning; even if we fail, we learn from what caused us to fail to improve the outcome later. We do not see obstacles or issues as delays but as stepping stones to develop our skills, knowledge, and qualifications within an area to help our organization succeed.

When developing a workforce to become agile, according to (Teece et al., 2016), "Competency requires the capacity to refresh current or future skills to adapt a company to environmental changes." A team is most willing to change when individuals feel prepared or competent to execute change. (R. Qin & D. A. Nembhard, 2015) emphasize that competence: workers have the correct information and knowledge to do the job. Breu et al. further elaborates that competency consists of developing new skills and competencies, acquiring the skills necessary for business process change, innovating management skills, and acquiring new IT and software skills.

How can organizations achieve competency? (Aburub, 2015) explains competency can be achieved by applying an organization's strategic vision, using appropriate technology (either hardware or software), producing quality products or services, changing management, making cost-effective, increasing the rate at which new products are introduced, having multi-venturing capabilities, developing business practices that are difficult to copy, increasing operational efficiency and effectiveness, cooperating across functional boundaries, and integration.

Once competency is achieved, per (Aburub, 2015), the organization's aims and goals can be reached efficiently and effectively.

2.3.2 Flexibility

"Flexibility is achieved when we have a flexible mind, which is open to alternative resources, different opinions, and ways of solving problems" (Akkaya & Tabak, 2020). To change an organization, we must be willing to change and recreate the organization. We must boldly allow others to explore and become creative to change and become the future version. A flexible organization is more willing to take the risk to create new products, explore new things, and is more inclined to embrace change. This type of mindset will be of great benefit to any stakeholder, especially those leading agile companies.

(Sherehiy & Karwowski, 2014) Identified flexibility as the ability to pursue different business strategies and tactics and quickly change from one method, task, or job to another. Flexibility ties into the definition of agile because it must be willing to change for a company to market quickly. Per (Aburub, 2015), organizational flexibility is an organization's capacity to adjust its internal structures and processes in response to environmental changes. Therefore, flexibility could be considered the main factor of an organization's agility, allowing it to deal successfully with changes.

(Nejatian et al., 2018) proposed the term "flexibility" as one of the main foundations of agility. Without flexibility, companies could miss critical moments to change that will significantly benefit their organization. According to (Koçu, 2018), organizations must be flexible and quick to make appropriate decisions in the face of market and customer-related changes.

Being flexible is all about how we deal with changes. (R. Qin & D. A. Nembhard, 2015) state, "Flexibility is planned responses to anticipated contingencies." Unfortunately, companies cannot avoid all changes, but flexibility in navigating changes is vital for an agile workforce.

2.3.3 Responsiveness

Responsiveness is another crucial characteristic of workforce agility, requiring the workforce to react quickly and positively to a changing environment. (Raschke, 2010) responsiveness is "the ability to react purposefully and within an appropriate timescale to significant events, opportunities, or threats to bring about or maintain a competitive advantage." Then (Aburub, 2015) elaborates that "Organizations need to

rapidly reconfigure, modify, and change the way they work to respond to either internal or external changes in the business environment."

When the workforce can respond quickly to changes within the organization, it provides a competitive advantage (Akkaya & Tabak, 2020), enabling the company to remain successful among its competitors. For effective change to occur within an organization, it starts within the higher level of the workforce. (Koçu, 2018) pointed out that it is vital for the management teams to quickly respond to changes by implementing the correct coaching inspiring the workforce while understanding how to implement changes to the products and services before competitors.

Ensuring that employees are aware of how change could occur and preparing them for the future early enables the workforce to better respond to workforce changes. (Kusuma et al., 2019) Further elaborate that for a workforce to be considered agile, responsiveness can be defined as the flexibility to respond to changes, quick to adapt if change happens, and swift workforce upskilling.

One could argue that the management team must proactively prepare the workforce to respond to changes through training, empowerment, and inspiration. For effective change to occur, it must come from the higher level and then trickle down to the workforce. For the change to be effective, the teams need to be competent in developing new skills to respond quickly to the changing market.

2.3.4 Adaptability

(Muduli, 2013) described an adaptive agile workforce as comfortable with change, new ideas, and new technologies. The workforce must be willing to adjust the business objectives and act quickly in line with the latest business direction. According to (Muduli & Pandya, 2018), Adaptive behavior requires professional flexibility, which is the ability to assume multiple roles, change quickly from one position to another, and the ability and competency to work simultaneously on different tasks in different teams. In other words, everyone must be willing to sacrifice for the organization to be successful in its new capacity. Everyone must be ready to pick up the slack, learn new skills, and ensure all gaps are covered.

For the teams to adapt, some members may have to work in positions they have never worked in and become comfortable developing a new skill set. Being agile requires adaptability, which means being willing to re-engineer yourself for your company's success. As you re-engineer yourself, also be willing to teach others the new skills you acquire and develop other team members.

Picking up a new skill, learning multiple new skills, or gaining new knowledge to adapt and succeed in a new environment is a crucial component of agility. As (Alavi, Muhamad, & Arbab Shirani, 2014) state, "Adaptability requires changing or modifying oneself or behaviors to fit the new environment better, whether it be interpersonal or cultural adaptability; spontaneous collaboration or even learning new tasks and responsibilities."

The culture of the work environment will change, and everyone must be willing to adapt and embrace the new changes. (Braun et al., 2017) while we are adaptive to the new products and services provided, we must also be flexible in pursuing different tactics and quickly changing from one strategy to another.

2.3.5 Team Building/Teamwork

Six of the journal articles used to define an agile workforce identified team building or teamwork as the main characteristic of workforce agility. Since most of us were children, we have been told that teamwork makes the dream work, meaning we can accomplish any goal when we work with others. In my culture, our Haitian flag has the motto "L 'Union Fait La Force," printed on it, which means, "Unity is strength." This means that when we are united and work as a team, we have the strength to accomplish anything.

Even in Christianity, in the bible, Genesis 11: 1-9, God scrambled communication by creating various languages during the construction of the tower of Babel. The humans had formed teams, and we worked together to build a staircase to heaven. Therefore, God scrambled the language to break down the communication to keep that from happening.

When we work together towards common goals, we can accomplish great things. We see this often in various industries and throughout the world. Even attempting to beat the Covid-19 pandemic has taken

teamwork from every country and person. We have all had to work together to wear a mask to slow the spread of the virus globally.

Working effectively requires each team member to put aside their selfish ambitions for the group's betterment. In creating an agile workforce, team members must be willing to work with others to help accomplish goals and quickly introduce new projects or bring new services to the market.

Per (Muduli, 2017), an effective and pleasant team environment provides workers with accurate, comprehensive, and meaningful business intelligence to make informed business decisions.

(Kusuma et al., 2019) Research proved how team participation achieved reliable plans and how teamwork enhanced critical thinking and problem-solving capabilities. When an organization works together to accomplish new goals and design new products, collectively, we can achieve great things.

2.3.6 Collaboration/Networking

As stated in the previous section about teamwork, many things can be accomplished if people work together in teams. Another teamwork method is when we collaborate or network with others, which can be defined as working towards a common goal.

While reading the journal article by (Menon & Suresh, 2021) about "Enablers of workforce agility in Engineering Educational Institutions, they identify why collaboration and networking are considered a characteristic of an agile workforce. When teachers collaborate at the various engineering institutions, it enables them to improve their teaching practice and enriches their learning by sharing and exchanging ideas and knowledge.

Working with others within and outside our organizations towards a common goal enables us to brainstorm and see ideas and various perspectives through different lenses.

(Jones, 2017) discussed agile working in law firms and stated that collaborations enable creative and innovative thinking. Still, mainly when we collaborate, we can improve communications and make time zones irrelevant. When we are willing to collaborate to improve a product or service, we are open to shifting meetings around to include team members from other time zones in the discussion. We value their

perspective and insight into our specific problems or issues. We are also willing to make the necessary sacrifices so that the relationship can flourish and grow, but mainly so that the service or product is successful. Therefore, reading the articles explains why networking and collaboration are identified as agile characteristics. We learn how to value people and the perspective they bring to the table.

2.3.7 Knowledge Sharing/Informative

Unsurprisingly, knowledge sharing and being informative are characteristics of an agile workforce. Knowledge sharing goes hand in hand with teamwork and collaboration since working with others allows us to learn from others, share knowledge, and become more informed.

(Kusuma et al., 2019) Define knowledge sharing as creating and maintaining knowledge for continuous improvements and effective effort. (Menon & Suresh, 2021) Furthermore, knowledge sharing is exchanging, processing, and transferring ideas, information, and knowledge among individuals within teams, departments, and institutions, facilitating new knowledge.

Sharing knowledge with others creates a dialogue that encourages new ideas and improvements among teams and individuals. Knowledge sharing does not always need to occur within our home departments; inviting others into the conversation about a particular issue may provide new insights and solutions to enable our workforce to become more agile.

There are many benefits of knowledge sharing within any organization. (Menon & Suresh, 2021) highlight in their article that knowledge sharing helps employees develop proactive, adaptive, flexible, and resilient behavior characteristics of an agile workforce. Agile workforces can gain these characteristics because they are equipped with the knowledge and understanding to change concepts and move quickly to make necessary organizational changes. Knowledge sharing enables people to contribute to the team, press forward, and succeed in a new area.

2.3.8 Training & Development

According to several journal authors and experts on workforce agility, agility cannot be achieved without leveraging employees' knowledge and skills (Dove, 1999); (Forsythe, 1993); (Plonka, 1997). The agile workforce has been claimed to capitalize on skills by proactively innovating their skill base ahead of need (Prahalad & Hamel, 1990); (Yusuf et al., 1999).

Organizations have different methods of training and developing their employees, such as cross-training and job rotations. These methods allow employees to work in another department for a certain period, learn a new skill, and be more flexible. (Hopp & Oyen, 2004) proved that cross-training is a powerful strategy that can ensure workforce agility. An effective training climate requires the organization to nurture and develop a learning environment, encouraging people to be more open and innovative in seeking new ideas. (Muduli, 2016). (Muduli, 2016) goes on to explain, "Organizational practices such as training and development enhance workforce competency level leading to feeling competent. Employees can perform a flexible range of tasks only if they have the necessary skill sets. Cross-training and job rotation can help workers adapt better to new jobs."

The agile workforce must have strong self-determination, which can only prepare them to respond instantaneously to customers' unexpected requests (Chonko & Jones, 2005). Through various studies (Muduli, 2016, 2017; Muduli & Pandya, 2018) and his team have proved that training and development are positively and significantly related to workforce agility.

(Muduli, 2017) also highlights that "Organizations committed to learning develop employees and managers who can manage and cope with changes. These individuals are more comfortable in performing new and proactive behaviors." (Gunasekaran et al., 2001) All of these characteristics enable a workforce to be agile.

2.3.9 Technology

For an agile workforce, technology development would be essential to have the tools necessary to succeed and make changes. Sometimes, technology is reinvented to work for a project; our team takes existing technology and makes it better to accomplish a new task. "Renewing technological capabilities, skills, and competencies that facilitate communication, collaboration, knowledge sharing, and learning. Technical know-how to design learning activities incorporating tools in enhancing teaching-learning effectiveness information technology (IT) and software skills to sense the environment, respond to stakeholders' needs, share information, and enhance learning (Breu & Hemingway, 2002); (McCully & McDaniel, 2007)

In their paper, (Nejatian et al., 2018) discuss how "a workforce can use technology-enabled platforms for collaborations and knowledge sharing to explore new learning. This cannot be ignored as the current generation is tech-savvy and needs to be taught how they are most comfortable. (Menon & Suresh, 2021) Technology changes so fast that it is easy to become outdated with the technology tools that one is using. However, maintaining a high level of technology is crucial for the company to survive in highly competitive environments."

Per (Goodarzi et al., 2018), an agile organization synchronizes processes and individuals with advanced technology. This helps fulfill the customer needs based on high-quality products and services in a relatively short period. Agile organizations realize the importance of allowing their workforce to advance and become proficient in using new technologies to enable the company to make quick changes and be more agile and flexible. The right technology can make it easier for a workforce to transition and better adapt to new models and services, creating an agile workforce.

2.3.10 Empowerment

(Liden & Arad, 1996) interpreted empowerment as the psychological outcome of organizational structural changes designed to provide power. It is a process of enhancing self-efficacy among organizational members by identifying conditions that foster powerlessness and through their removal by formal organizational practices and informal techniques providing efficacy information (Conger & Kanungo, 1988).

According to (Muduli, 2016), various factors enable psychological empowerment, promoting workforce agility. Those factors include organizational learning and training, reward systems, involvement, teamwork, and information systems. Each of these factors has been proven via his survey study to directly influence empowerment and workforce agility. "Psychological empowerment as employee cognition can promote workforce agility. Psychological empowerment in intrinsic motivation and self-efficacy can produce proactive, adaptive, and resilient behavior in the workforce. (Thomas & Velthouse, 1990) when individuals feel empowered, proactive behaviors such as flexibility, resilience, and persistence ensue. Empowered employees are more likely to be more adaptive because of the increased flexibility accompanying empowerment (Scott & Bruce, 1994)." (Muduli & Pandya, 2018)

Not only do people enjoy recognition and rewards, but people also want power and entitlement. Per (Suofi et al., 2014), "Agile organizations support their workforce by hiring 'knowledgeable workers,' giving 'top management support and employee empowerment and continuing 'training and education." When the management empowers the workforce, everyone works together as a team, and the power is shared. "Power-sharing practices offer the greatest potential to support the workforce agility architecture by improving efficiencies of training, switching, multitasking, and collaboration." (Muduli, 2013). "It is important for managers interested in fostering workforce agility to enhance psychological empowerment of the workforce by adopting suitable organizational practices such as information sharing, skill acquisition and development, team accountability, autonomy through boundaries, team accountability,

reward system and workplace independence and flexibility (Muduli, 2013) are necessary for enhancing psychological empowerment which has potential to foster workforce agility." (Muduli, 2016)

2.3.11 Organizational Culture of Change

Within five journal articles reviewed, organizational culture was surveyed and identified as a characteristic of an agile workforce. According to (Kusuma et al., 2019) and (Sherehiy, 2008), organizational change is an organizational assumption, beliefs, and values shared organization-wide to succeed in the marketplace. These assumptions, ideas, and values encourage or discourage change within the organization and determine the rate at which change will occur.

In their article about agile working in law firms, (Jones, 2017) discuss the benefits of culture within an organization, such as retaining a diverse pool of talent and empowering employees. He states that a diverse talent pool should be supported by management and provide different solutions when working with various clients. Organizations must instill a culture of empowering their workforce to motivate their teams to create new products and services. Reminding and encouraging their workforce why it is essential to be first to market but building a "Can Do" attitude within the culture.

(Dubey & Gunasekaran, 2015) Further, discuss how to change the organizational culture and create an agile workforce; formal information-sharing programs and empowerment through mastery over skills should be implemented. Creating a sense of togetherness within the culture allows team members to freely give suggestions without failure, enabling the organization to move forward.

2.3.12 Incentives, Rewards & Recognition

So why would incentives, rewards, and promotions be a characteristic in defining workforce agility? It is acknowledging your workforce and their efforts to promote change. It is motivating because, let us face it, people love to be recognized for their contributions and efforts when helping the organization.

There are many ways to recognize team members for their contributions; it does not always need to be monetary. Sometimes just the vocal recognition that someone is doing a great job or helping to advance

the organization helps someone and motivates him or her to help the organization succeed. Recognition motivates us to do better and to keep excelling.

(George et al., 2018) stated, "Key to agility is a focus on "people." The best approaches involve small self-organizing teams built around talented and highly motivated individuals, continuous attention to technical excellence, and sound design that enhances agility. This characteristic of agility focuses on doing something for the workforce to press towards helping the organization with new ideas that are a success.

According to (Muduli, 2013), improvement-based incentives, non-monetary rewards, skill-based pay systems, etc., promote workforce agility since employees are rewarded for the number and depth of new skills. He further states, "agility behavior is directly related to intrinsically motivated and satisfied people, and during a research study in 2016, (Muduli, 2016) survey results verified that a reward system was found to positively and significantly impact workforce agility.

(Menon & Suresh, 2021)further, elaborate that "rewards and recognition can be monetary or non-monetary and is very helpful in acknowledging and appreciating faculty members and staff efforts in achieving new organizational goals. The actions and work that a workforce puts in to create a new project or service should be rewarded and recognized to create an agile workforce.

2.3.13 Speed & Quickness

Since these terms are closely related in their definitions, they have been merged under one heading for this literature review.

According to (Sherehiy, 2008), the most essential factor for agility in organizations is developing new skills and the speed of acquiring the skills needed for business process change. This would tie into the competence of a workforce to build upon the skills they already have, develop new skills to be successful, and operate in a different environment.

(Aburub, 2015) stated that speed might also include learning, carrying out tasks and operations, and making changes in the shortest possible time. It is progressive when organizations anticipate changes and

ensure their organizations are ready for those changes. (Akkaya & Tabak, 2020) Added, "Speed is about the decision-making process. Speed is important for a company to develop new knowledge against the changes in innovation capabilities. This enables a company to offer products and services efficiently and rapidly."

When an organization is competent in skills and has the proper training and knowledge about a new product or process, speedy improvements and decisions can be made effortlessly. When organizations are not ready for the changes or do not anticipate the changes coming, the workforce's more considerable resistance could change despite the changing environment. According to (R. Qin & D. A. Nembhard, 2015), quickness involves the work pace after changes measured by a worker's problem-solving speed, the steady-state average working speed of new products or services.

It is accurately stated by (Sherehiy, 2008) that to be considered agile in a workforce, an organization needs to execute business operations swiftly in delivering products/services to market. In addition, per (Kusuma et al., 2019), that means performing tasks in the shortest possible time.

2.3.14 Proactivity

In reviewing the papers, it was hard to believe that proactivity only scored four journal articles that listed it as a primary attribute of an agile organization. (Sherehiy & Karwowski, 2014), (Alavi, 2016) and (Braun et al., 2017) all listed proactivity as a vital characteristic of an agile organization. They also all defined proactivity as the initiation of activities that have positive effects on a changed environment. Braun further discussed how it is essential for organizations to proactively identify and implement change when needed so they can move forward in becoming agile.

Proactivity provides organizations the foresight to identify and anticipate issues or problems related to upcoming changes. They can also predict possible outcomes and needs of the workforce to effectively hire to ensure the proper skillsets are captured within the company. By identifying issues early, organizations can map out a plan for resolving issues promptly and ensure the correct skills are possessed

within the company. This enables organizations to press forward in quickly creating new products and services, hence defining their organization as agile.

The previously identified agile characteristics, such as teamwork, networking, adaptability, and resilience, work alongside proactively to define agile organizations. To proactively identify future issues, knowledge sharing and even competence of team members and individuals are required of the teams. As we have read earlier in this paper, when individuals are trained and empowered, they are confident about changes that should be made. In addition, when team members are knowledgeable and competent, they better understand what it will take to sustain a product or service. They can anticipate future problems and help create solutions and hurdles over problems so the team can be first to market with new services and products and continually succeed.

2.3.15 Resilience

In reviewing the papers, it was also hard to believe that resilience only scored four journal articles that listed it as a primary attribute of an agile organization. (Sherehiy & Karwowski, 2014), (Alavi, Abd. Wahab, et al., 2014) and (Braun et al., 2017) all listed resilience as a critical characteristic of an agile organization, and many of the other journals should have done the same. All these researches defined resilience as efficiently functioning under stress despite changing environments when applied strategies and solutions have failed.

When tackling a new problem or developing a new service, the organization seldom gets the concept correct on the first attempt. What is the driver that keeps a workforce pressing forward toward a successful outcome amid failure and stress? How does an employee become resilient amid change? In addition, how do companies help their individuals cope with the stress of change?

The answer to this question is different for all individuals. Since every workforce and all individuals handle stress differently. Resilience is needed within agile workforces because it is the necessary bounce back that all employees and organizations need when dealing with change or failure. The "Can Do" attitude reminds us to learn from our current situation but to keep pressing forward because we are almost

at our breakthrough within a project. Alongside the other agile characteristics defined earlier in this paper, resilience keeps the team pressing past hurdles until they receive the desired outcome or service to go to market. Resilience is the knowledge base of knowing how to solve a problem. It also utilizes the collaboration stabled to support teams and lessons learned so we can keep pressing forward in our workforce.

2.3.16 Employee Involvement

Moreover, the last agile characteristic is employee involvement. For any workforce to be considered agile. The people that make up that workforce or organization must be willing to be agile. The employees must be involved and possess all the characteristics of agility to ensure their organization is agile. Team members and organizations must be competent in their skills and abilities, flexible in planning and learning, responsive to the changes that need to take place, adaptable and willing to make changes; be willing to work and build teams while working and collaborating with others to share ideas and concepts; be willing to learn and share knowledge; take training to sharpen skills; learn new technologies; be empowered; develop a culture of change; managers should be willing to provide incentives, rewards & recognition, as we press with speed to learn while being proactive and looking ahead.

In order to have an agile workforce, you must have the involvement of all employees to be successful. Per Braun, the quicker our teams and organizations adapt to change, the quicker we can design and build new services and products for the market.

(Menon & Suresh, 2021) point out that employees need the correct level of management support, communication, training, and development to make the commitments necessary to help their workforce be agile and successfully perform in a new market. Mudali also emphasizes that psychological empowerment is vital for employees to be involved and to create an agile workforce.

2.4 Benefits of an Agile Workforce

If you have gotten to this point in the paper, you understand agility and the characteristics defining an agile workforce. Therefore, after reading, would you have an excellent team to accomplish anything if they were responsive to the market and your stakeholders? What if they were competent in their abilities while being flexible to be first or quick to market with changes; a team that understands technology, is trained and receives the recognition for making the fundamental changes to make the organization successful, and is empowered by management?

In the numerous conference papers referenced within this literature review, we have defined workforce agility and how it has been studied in various industries. These companies have provided details on the benefits of having an agile organization. Hospitals, Law firms, and educational institutions have discussed how an agile workforce has allowed their workforce to enhance their stakeholders' services. All teams embrace agility because it has the potential to develop "a flexible and multi-skilled workforce, creating a culture which allows initiative, creativity, and supportiveness to thrive throughout the organization" (Gunasekaran et al., 2001).

Having a workforce that can react and adapt to changes appropriately and promptly has benefits too numerous, to name all. Agile workers can adjust quickly and easily to new tasks, so delays in shifting between products and the time it takes to get up to speed decrease significantly. Workers with multiple skill sets should be able to produce various products. An agile workforce also expands the manufacturing of composite products and the installation of new product lines by anticipating customers' needs (Alavi, 2016).

In "It Pays to be Agile (Dattero et al., 2017), the benefits of an agile workforce are defined as follows:

- Manage Changing Priorities
- Project Visibility
- Improve Team Morale
- Improve IT/Business Alignment

- Accelerate Time to Market
- Enhance Software Quality
- Reduce Risk
- Simplified Development Process
- Enhance Software Maintainability
- Manage Distributed Teams
- (Dattero et al., 2017) further, iterate that investing in the training of the workforce helps in adopting an agile workforce, and your team's mindset will be more prepared to:
- They understand the system as a whole.
- They adopt a catalyst style of leadership.
- Their organization is based on continuous learning from experiments.
- They foster an open communication style.
- Their governance is based on long-term business value and adaptation.
- Their members seek mastery in their respective skills. (Dattero et al., 2017)

"Agility is a new solution for managing a dynamic and changing environment. Surviving and prospering in a competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets driven by customer-defined products and services requires an agile workforce. (Muduli, 2016)

Workforce agility is the goal of many organizations because everyone would love to work for and manage an organization that can respond "(a) to dynamics and threats in the best possible way and in the shortest possible time (Rajan et al., 2012); (Sherehiy, 2008) and (b) identifying and capitalizing on opportunities in the most effective and timely manner (Sharifi & Zhang, 1999)." (Muduli & Pandya, 2018)

2.5 Literature Review Summary

The literature review identified critical factors for creating an agile workforce. It has also provided insight into understanding the various characteristics of workforce agility and why these characteristics are essential. However, the reviewed studies did not define workforce agility within the aerospace industry or provide details on what has enabled NASA KSC to shift from the Space Shuttle program to the Artemis program.

This study explicitly addresses this knowledge gap by focusing on answering the following questions:

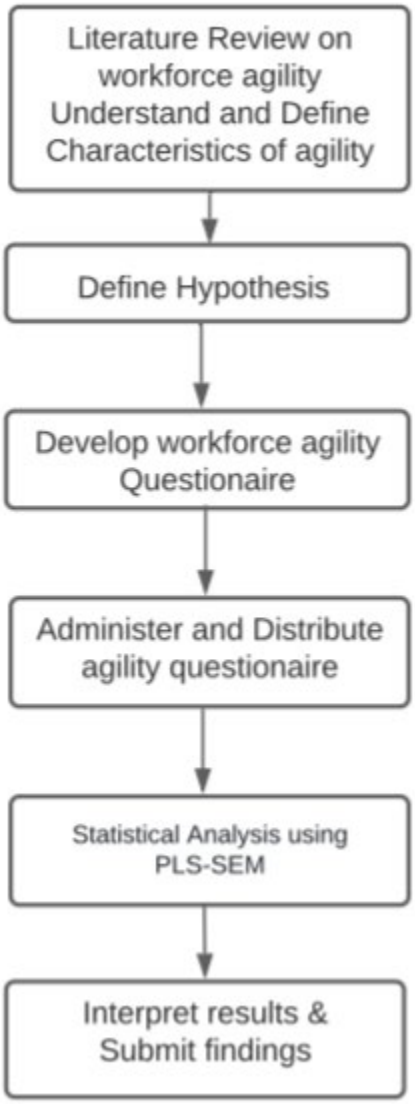
- RQ1: What are NASA's agile characteristics?
- RQ2: How do we measure NASA's workforce agility?
- RQ3: Does NASA have any concerning characteristics as they press to be an agile workforce?
- RQ4: What can other industries learn from NASA KSC's workforce agility model?

CHAPTER THREE: METHODS & PROCEDURES

3.1 Summary of Selected Methodology

In order to study agility at the NASA Kennedy Space Center, this research will require a well-defined methodological approach. This section focuses on how research will be conducted to define workforce agility and the methodology necessary to receive the correct results. Table 8 lays out the process that will be used to develop the methodology for this research.

Table 8: Methodology for Study



During this research, the following steps will be utilized to collect and analyze data per the steps identified in Table 8:

1) A literature review was conducted to identify, understand, and define the characteristics of workforce agility. The literature review also helped to identify the gaps in workforce agility research and how this research can progress.
2) The hypothesis phase helps to define this research's goals and scope of study. It provides the focus areas of this research and the areas we are attempting to address.
3) During this phase, a questionnaire will be created to highlight the characteristics of workforce agility under study.
4) The questionnaire will be distributed and administered to the population to collect the data needed to validate the hypothesis.
5) Utilizing Structural equation modeling (SEM), the data collected in Step 4 will be validated.
6) The data collected will be interpreted utilizing SEM, and the findings will be documented in this paper's later chapters.

3.2 Proposed Research Model and Hypotheses

Understanding workforce agility within the aerospace industry is difficult because there is a lack of information on how to define it within the industry, as agility is a new solution for managing a dynamic and changing environment. Sufficient information has yet to be captured from the literature reviews to understand what survey methods could be used to define workforce agility within the aerospace industry.

For this study, we developed the model to understand agility at NASA KSC within the Engineering workforce. It possesses the key agility characteristics identified during the literature review to help us explore and understand agility within this workforce. During the literature in Section 2 of this paper, workforce agility was defined by seventeen characteristics, which were defined and interpreted per the journal articles reviewed. In reviewing the research methods and findings of each article, the

characteristics were grouped, and their relationships to the other terms were defined. This enables the understanding of how each of the terms influenced each other

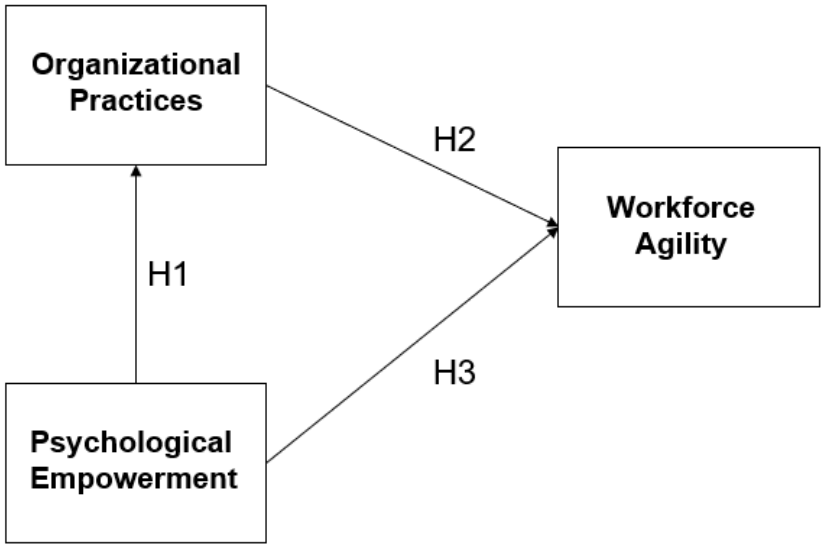


Figure 1: Relationships and Associations

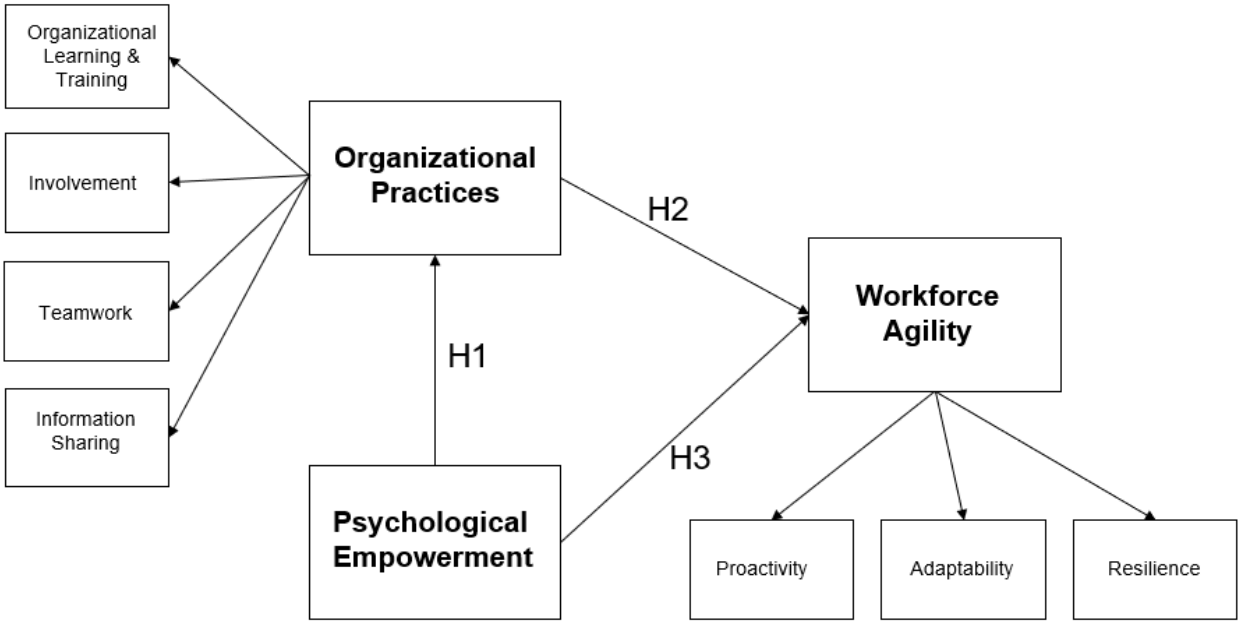


Figure 2: Proposed Research Model with Indicators

The following hypotheses are proposed to test the structural relationships among the models:

- *H1: Psychological empowerment positively affects organizational practices*
- *H2: Organizational practices positively affects workforce agility*
- *H3: Psychological empowerment positively affects workforce agility.*

3.3 Survey Instrument

To support the hypotheses identified in 3.2 Proposed Research Model and Hypotheses, the 26 literature papers used to define workforce agility to determine what research method was used to define workforce agility within the paper. It was discovered that 19 of the papers utilized survey questionnaires to define workforce agility. Another five papers utilized literature reviews to support their evidence for defining workforce agility and finally four articles performed interviews or site visits to gather data to define it. For this paper, we will utilize a survey questionnaire to study and understand the workforce.

Table 9: Methods for defining Workforce Agility

Author and Publication	Method for defining Agility		
	Survey Questionnaire	Literature Review	Interview/ Site Visits
(Aburub, 2015)	X		
(Akkaya & Tabak, 2020)	X		X
(Alavi, 2016)	X		
(Alavi, Abd. Wahab, et al., 2014)	X		
(Aidan et al., 2018)	X		
(Braun et al., 2017)	X		
(Dattero et al., 2017)	X		
(Dubey & Gunasekaran, 2015))	X		
(Goodarzi et al., 2018)	X		
(Gyemang & Emeagwali, 2020)	X		
(Jones, 2017)		X	
(Koçu, 2018)	X		
(Kusuma et al., 2019)	X		
(Menon & Suresh, 2021)	X		X
(Muduli, 2013)		X	
(Muduli, 2016)	X	X	
(Muduli, 2017)	X		
(Muduli & Pandya, 2018)	X		
(Munteanu et al., 2020)	X		
(Nejatian et al., 2018)			
(R. Qin & D. A. Nembhard, 2015)			
(Sherehiy & Karwowski, 2014)	X		

(Suofi et al., 2014)	X		
(Suresh & Patri, 2017)			
(Tripathi et al., 2020)			

The survey to be used for this research has been posted in APPENDIX C: SURVEY INSTRUMENT and within Table 10: Survey Statements of this document. In order to create the survey questions, past successful surveys were used to create our survey for this study. The survey developed by (Muduli, 2017) and (Sherehiy & Karwowski, 2014) were used to develop the various sections of the survey.

3.4 PLS-SEM

Partial least squares structural equation modeling (PLS-SEM) is a popular method for estimating path models with latent variables and their relationships (Sarstedt et al., 2021). PLS-SEM estimates the parameters of a set of equations in a structural equation model by combining principal component analysis with regression-based path analysis (Mateos-Aparicio, 2011). A common goal of PLS-SEM analyses is identifying critical success factors (Hair et al., 2011) since it accounts for the total variance and uses the total variance to estimate parameters (Hair et al., 2019). PLS-SEM enables researchers to estimate complex models with many constructs and indicator variables, enabling researchers to understand the causal relationships derived from theory and logic (explanation) and a model's predictive power (Hair Jr et al., 2023). PLS-SEM is more likely to identify an effect as significant when it is present in the population (Ringle et al., 2023; Sarstedt et al., 2021).

(Ringle et al., 2023; Sarstedt et al., 2021) The article helped identify several critical reasons for utilizing PLS-SEM for this study. PLS-SEM was chosen to help predict and explain key target constructs since the complex structural model included many constructs, indicators, and several model relationships (Hair, 2018). Lastly, the research is based on secondary data, needing more comprehensive substantiation based on measurement theory (Ringle et al., 2023). PLS-SEM provides researchers with the benefit of high degrees of statistical power by identifying relationships as significant when they are present (Hair et al., 2019).

For this research, SMART PLS will be used to analyze the data.

CHAPTER FOUR: RESEARCH FINDINGS

4.1 Materials and Methods

Understanding workforce agility within the aerospace industry is difficult because no data provides any information or details on how workforce agility is defined within the aerospace industry. Since agility is a new solution for managing a dynamic and changing environment. Surviving and prospering in a competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets driven by customer-defined products and services requires an agile workforce. (Muduli, 2016). Sufficient information has yet to be captured from the literature reviews to understand what survey methods could be used to define workforce agility within the aerospace industry.

4.2 Research Hypotheses

Workforce agility is the goal of many organizations because everyone would love to work for and manage an organization that can respond "(a) to dynamics and threats in the best possible way and in the shortest possible time (Rajan et al., 2012; Sherehiy, 2008) and (b) identifying and capitalizing on opportunities in the most effective and timely manner (Muduli & Pandya, 2018; Sharifi & Zhang, 1999).

Our goal during this research is to understand the characteristics of workforce agility and NASA and how those terms affect the workforce. Finding a proven research survey to address all the agility terms we wanted to explore for this paper took much work. However, we were able to locate two proven surveys and merge the terms. The terms were merged to understand the impacts of relationships and how they pertain to workforce agility. The models for this study were discussed and merged through a rigorous conceptualization process to identify the top surveys that could help us build the correct relationships to provide a viable survey to define the characteristics of workforce agility at NASA KSC.

In order to create the survey questions, past successful surveys were used to create our survey for this study. The survey developed by (Muduli, 2017) and (Sherehiy & Karwowski, 2014) were used to develop the various sections of the survey listed in Table 10.

Table 10: Survey Statements

OLT: Organizational Learning & Training Source: (Muduli & Pandya, 2018)		1	My organization encourages and facilitates learning and training to enhance my adaptability and flexibility in the changing business environment.
		2	My organization systematically lays out individuals' training requirements.
		3	My organizational culture makes employee learning a top priority.
I: Involvement Source: (Muduli & Pandya, 2018)		1	Management in my organization encourages input and feedback from employees, especially on decisions that affect employee services and well-being.
		2	Employees in my organization are encouraged to involve in decision-making
		3	Employees in my organization are given opportunities to be involved in decision-making
TW: Teamwork Source: (Muduli & Pandya, 2018)		1	My organization encourages me to work in teams.
		2	My organization promotes internal teamwork.
		3	My organization encourages external teamwork.
		4	My organization promotes intragroup teamwork.
		5	My organization encourages cross-functional teamwork.
IS: Information Sharing Source: (Muduli & Pandya, 2018)		1	My organization encourages frequent organizational conversation that keeps alive the lessons learned from history.
		2	My organization promotes specific mechanisms for sharing lessons learned in organizational activities from department to department (unit to unit, team to team).
		3	Top management repeatedly emphasizes the importance of knowledge sharing in my organization.
PE: Psychological Empowerment Source: (Muduli & Pandya, 2018)		1	The work I do is very important to me.
		2	My job activities are personally meaningful to me.
		3	The work I do is meaningful to me.
		4	I am confident about my ability to do my job.
		5	I am self-assured about my capabilities to perform my work activities.
		6	I have mastered the skill necessary to perform my job.
		7	I can decide on my own how to go about doing my work.
		8	I have considerable opportunity for independence and freedom in how I do my job.
		9	My impact on what happens in my department is large.
		10	I have significant influence over what happens in my department.
WA-P: Proactivity Source: (Sherehiy & Karwowski, 2014)		1	I am able to solve new and complex problems at work
		2	I address difficulties in my tasks before they become major problems
		3	I look for the opportunities to make improvements at work
		4	When I see something that I do not like, I am trying to fix it
		5	I am trying to find out more effective ways to perform my job
		6	I design new procedures or processes for my work area
		7	I am trying to think "outside the box" in order to solve problems
		8	I find new ways to obtain or utilize resources when resources are insufficient to do my job

WA-A: Adaptability Source: (Sherehiy & Karwowski, 2014)		How easy or difficult is it for you to handle the following situations?
	1	Change my behavior to work more effectively with other people
	2	Accept critical feedback
	3	Communicate well with people of different backgrounds
	4	Adjust to new work procedures
		How quickly or slowly do you learn new knowledge or skills needed in the following situations?
	1	Use new equipment at work
	2	Keep up to date at work
	3	Perform new tasks at work
		How quickly or slowly do you adjust to the following situations?
	1	Switch from one project to another
	2	Change your way of doing things to suit co-workers who have different ways of performing a job
	3	Change plans when the necessary supplies or equipment are suddenly unavailable
WA-R: Resilience Source: (Sherehiy & Karwowski, 2014)	1	I am reluctant to accommodate and incorporate changes into my work
	2	I like to change old way of doing things
	3	I am tolerant to situations where things seem confusing
	4	I am able to work out what to do when work instructions are unclear
	5	I remain calm and composed when faced with difficult circumstances
	6	I am able to perform my job efficiently in difficult or stressful situations
	7	I am able to work well when faced with a demanding workload or schedule
	8	When a difficult situation occurs, I react by trying to manage the problem
	9	I drop everything and take an alternate course of action to deal with an urgent problem

Each workforce agility factor had at least three survey questions to address the factor. The NASA and UCF Internal Review Boards (IRBs) reviewed and approved the survey statements. The survey variables were measured on a 5-Likert scale, where a score of 1 = strongly disagree, extremely difficult or extremely slow; 2 = disagree, somewhat difficult or somewhat slow; 3 = Neither agree nor disagree, Neutral -Neither Easy nor Difficult or Neutral – Neither slow or Quick; 4 = agree, somewhat easy or somewhat quickly and 5= Strongly agree, extremely easy or extremely quickly.

4.3 Data Source

We aimed to learn more about NASA KSC's agile characteristics and what enabled NASA to shift from the Space Shuttle program to the Artemis program. The largest NASA department at KSC is the Engineering department. Therefore, a protocol was followed to obtain permission to email the approved IRB survey to the NASA KSC Engineering department. Although only some people within the current workforce supported the Space Shuttle program, permission was given to survey all personnel supporting various engineering levels to understand the engineering workforce's agility. The minimum sample size should be ten times the most significant number of formative indicators used to measure one construct (Hair et al., 2011). We determined a minimum of 200 completed survey responses was required to build and complete the Structural Equation modeling for this study. A total of 280 surveys were received to satisfy this requirement.

4.4 Data Analysis Method

This study used Microsoft Forms to transmit the survey to the KSC Engineering workforce via an internal email link. The survey link and supporting IRB documents were sent out to the NASA KSC Engineering workforce. The data was returned anonymously to Microsoft forms. The results were saved within Microsoft Excel, and the software tool used to perform data analysis was SmartPLS version SmartPLS 4.0. Utilizing PLS-SEM within the software tool, the research hypothesis was tested and proven.

4.5 Validate Survey Responses

When the surveys were received by Microsoft Forms, each survey was reviewed to ensure that consent was provided by each participant. The surveys were also reviewed to ensure no data was missing and all questions were addressed. Any survey with missing data would cause different samples sizes for each variable dimension during data analysis and would not have been suitable for regression and correlation analyses (Gibson et al., 2022). None of the surveys received were omitted from this study. All except one participant provided consent, and all survey participants addressed all questions within the survey.

4.6 Survey Demographics

Over 625 surveys were sent to the NASA KSC engineering workforce via the email distribution link, and 281 were received, but one survey was omitted since the participant declined to consent to participate in the survey study. Therefore, 280 valid survey responses were received, yielding a 45% response for this survey. Table 11 show the gender and current role demographics received. Table 11 shows that 76 (27.1%) of the 280 participants in the research survey were female, compared to 197 (70.4%) male participants. For the participants' current role, Systems Engineering and Integration personnel had the most significant representation, with 15% of study participants, while the second largest group was Design Engineers (14%), followed by Project Managers (13%). The other participating roles were Engineering managers and Operations Engineers at 11% each, followed by Sub-system or Component Level Engineer at 10%, other roles at 9%, Engineering Support Personnel at 6%, Test Engineer at 4%, and Chief Engineers and Engineering Analyst at 3% each.

Table 11: Gender and Role Demographics *(n*=280)

Gender	Total	Percentage
Male	197	70%
Female	76	27%
Prefer not to say	7	3%
Current Role	Total	Percentage
Chief Engineer	9	3%
Systems Engineering & Integration	41	15%
Project Manager	36	13%
Sub-system or Component Level Engineer	29	10%
Engineering Analyst	9	3%
Engineering Manager	30	11%
Design Engineer	39	14%

Table 12 lists the Years worked in the Aerospace Industry and the NASA Programs supported demographics. In Table 12 we find the highest number of participants have worked 11-19 years or 30-39 years at 31.4% each, with the second highest percentage of participants having worked in the industry less than 5 years 16.4%. This is followed by 6-10 years at 9.6%, 20-29 years at 9.3%, and lastly greater than 40 years at 1.8%.

Table 12: Years worked & NASA Programs Supported Demographics (*n*=280)

Years worked in the Aerospace Industry	Total	Percentages
<5 years	46	16%
6-10 years	27	10%
11-19 years	88	31%
20-29 years	26	9%
30-39 years	88	31%
>40 years	5	2%
NASA Programs supported	Total	Percentages
Commercial Crew	78	28%
International Space Station	76	27%
Space Shuttle	113	40%
EGS/Artemis/Constellation	189	68%
HLS/Gateway	52	19%
Research & Technology	91	33%
Launch Services	87	31%
Other	49	18%

To review the details provided for NASA Programs in Table 12, we find that 67.5% of survey participants supported the EGS/Artemis/Constellation program, followed by 40.4% who supported the Space Shuttle Program, 32.5% for Research and Technology Programs, 31.1% for the Launch Services program, 27.9% for the Commercial Crew Program, 27.1% for the International Space Station program, 18,6% for the HLS/Gateway program, and, lastly, 17.5% for other programs.

4.7 Measurement Model Assessment

In order to validate the statistical model, there are methods provided by (Hair et al., 2019), (Hair Jr et al., 2021), and (Azyabi et al., 2022). First, it recommended Measurement Model Assessment by inspecting Cronbach's Alpha. Per (Hair et al., 2015; Hair et al., 2019). Cronbach's Alpha and Composite Reliability (Rho_C) are used to measure internal consistency reliability. The Cronbach's Alpha should be greater than 0.7 for each construct, and the Composite Reliability should be greater than 0.8 per construct. (Aljuaid et al., 2022). Cronbach's alpha values for each group of indicators are higher than .8, which indicates excellent consistency. Also, all the reliability measures were above .7, which indicates high consistency. Then, we reviewed the Average Variance Extracted (AVE), which is a metric used for evaluating a construct's convergent validity for each construct. The Average Variance Extracted (AVE) should be greater than 0.50 (Hair et al., 2019). During the first run of the program, two AVE values were below .5 and considered unacceptable per Table 13.

Table 13: Initial Model Validity Inspection

	Cronbach's Alpha	**Composite Reliability (Rho_C)**	**Average Variance Extracted (AVE)**
Organizational Practices	.925	.935	.510
Psychological Empowerment	.880	.89	.447
Workforce Agility	.915	.924	.314

Since the AVE values are not acceptable per Table 13, we will review the Outer Loadings. The Indicator Reliability is captured by the Outer loadings, which represent the reliability of the indicator in the construct. Outer loadings greater than .6 are recommended. (Hair et al., 2019) Outer Loadings greater than 0.6 are considered strong evidence of convergent validity, and Outer loadings less than 0.6 (should be eliminated) (Hair Jr et al., 2021). During the inspection, 26 Indicators were identified that needed to be deleted due to their Outer loadings being less than 0.6 results (Hair Jr et al., 2021). Once the indicators

were removed from the model, there was an Improved Cronbach's Alpha and Improved AVE for each of the constructs.

The following 26 Indicators were deleted since their outer loadings were less than .6.

- Organizational Learning and Training 1 (OP-OLT1)
- Psychological Empowerment 6 (PE6)
- Psychological Empowerment 7 (PE7)
- Psychological Empowerment 8 (PE8)
- Workforce Agility: Inadequate average variance extracted
    - Workforce Agility: Adaptability WA-A (All terms): WA-1, WA-2, WA-3, WA-4, WA-5, WA-6, WA-7, WA-8, WA-9, WA-10, WA-11, WA-12
    - Workforce Agility: Resilience WA-R (All terms): WA-R1, WA-R2, WA-R3, WA-R4, WA-R5, WA-R6, WA-R7, WA-R8, WA-R9
    - Workforce Agility: Proactivity 6 (WA-P6)
    - Workforce Agility: Proactivity 8 (WA-P8)

All values fell into range once the indicators were removed. The improved values from the deletion of the indicators are listed in Table 14. All Cronbach's Alphas values for each group of indicators are higher than 0.8, which indicates excellent consistency. All Composite Reliability (Rho_C) measures were above 0.7, which indicates high consistency, and all Average Variance Extracted (AVE) values are above .5 and considered acceptable. The final model will carry the acceptable values captured in Table 15: Internal Consistency and Convergent Validity.

Table 14: Validity Inspection 2nd attempt

	Cronbach's Alpha	**Composite Reliability (Rho_C)**	**Average Variance Extracted (AVE)**
Organizational Practices	0.927	0.937	0.534
Psychological Empowerment	0.856	0.890	0.538
Workforce Agility	0.866	0.900	0.599

Table 15: Internal Consistency and Convergent Validity

Factor	Variables	Indicators	Outer Loadings	Cronbach's Alpha	Composite Reliability	Average variance Extracted (AVE)
Organizational Practices	Involvement (OP-I)	OP_I1	0.723	0.927	0.937	0.534
		OP_I2	0.823			
		OP_I3	0.789			
	Information Sharing (OP-IS)	OS-IS1	0.79			
		OS-IS2	0.686			
		OS-IS3	0.72			
	Learning & Training (OP-OLT)	OP-OLT2	0.625			
		OP-OLT3	0.759			
	Teamwork (OP-TW)	OP-TW1	0.701			
		OP-TW2	0.698			
		OP-TW3	0.718			
		OP-TW4	0.741			
		OP-TW5	0.709			
Psychological Empowerment	Psychological _Empowerment (PE)	PE1	0.731	0.856	0.89	0.538
		PE2	0.814			
		PE3	0.814			
		PE4	0.696			
		PE5	0.713			
		PE9	0.676			
		PE10	0.673			
Workforce Agility	Proactivity (WA-P)	WA-P1	0.791	0.866	0.9	0.599
		WA-P2	0.812			
		WA-P3	0.778			
		WA-P4	0.747			
		WA-P5	0.739			
		WA-P7	0.777			

The next step in performing the model assessment is to review the Discriminant Validity. For this, we review the Heterotrait - Monotrait ratio (HTMT) Criterion shown in Table 16 and the Fornell-Larker Criterion shown in Table 17. The HTMT is defined as the mean value of the item correlations across constructs relative to the (geometric) mean of the average correlations for items measuring the same construct if the HTMT is greater than 0.85 for structural models with constructs that are conceptually very similar. Alternatively, if the HTMT value is about .85, it suggests that discriminant validity is absent. (Henseler et al., 2015) And (Hair et al., 2019). For our model, the Heterotrait - Monotrait ratio (HTMT) Criterion values ranged from 0.531 to 0.720; therefore, we can confirm that the constructs are distinct.

Table 16: Heterotrait-monotrait Ration (HTMT)

	Organizational Practices	**Psychological Empowerment**	**Workforce Agility**
Organizational Practices			
Psychological Empowerment	**0.622**		
Workforce Agility	0.531	**0.720**	

Table 17 is shown for discriminant validity via the Fornell-Larcker criterion, which compares the square root of the AVE values with the latent variable correlations, with the idea that the constructs share more variance with their associated indicators than with any other construct (Hair Jr et al., 2021). For this model, it is proven that the square root of the AVE for each construct was higher than the correlation values between the latent variables (Azyabi et al., 2022).

Table 17: Fornell-Larcker criterion

	Organizational Practices	**Psychological Empowerment**	**Workforce Agility**
Organizational Practices	**0.731**		
Psychological Empowerment	0.566	**0.733**	
Workforce Agility	0.479	0.626	**0.774**

Lastly, in performing the measurement model assessment (Hair Jr et al., 2021), we will review the Variance Inflation Factor (VIF) in Table 18. Multicollinearity describes a relationship between variables that causes them to be correlated. Correlated helps us to see the mutual relationship or connection in which one thing affects or depends on another. Multicollinearity values are analyzed by reviewing the variance inflation factor (VIF), which is a measurement of the amount of multicollinearity in regression analysis (Hair et al., 2019).

For our model, we can observe that the relationship between Organization Practices and Psychological Empowerment is 1, and the relationship between Workforce Agility and Organizational Practices and Psychological Empowerment is 1.472, which is within range and proves there is a connection between the terms. Per the definitions provided by (Hair Jr et al., 2023), the preferred VIF is less than 3. Therefore, all VIF values for our model are within range and prove there is a connection between the terms (Hair Jr et al., 2021).

Table 18: Variance Inflation Factor

	Organizational Practices	**Psychological Empowerment**	**Workforce Agility**
Organizational Practices			1.472
Psychological Empowerment	1.00		1.472
Workforce Agility			

4.8 Structural Model Assessment

In this section, we will review the coefficient of determination (R2) in Table 19, F-Square (f2) effect sizes in Table 20, and Stone-Geisser's criterion **(**Q2) in Table 21 for the model's predictive relevance. The Model's predictive relevance was assessed to perform model validity checks (Hair Jr et al., 2021).

The coefficient of determination (R2) listed in Table 19 assess the model's predictive accuracy by defining the combined effect of indicators and constructs (Hair et al., 2019). R-squared or R2 is a statistical measure that shows how well the data fit the regression model (the goodness of fit). It also – similarly shows

how much change in the dependent variable can be accounted for by one of more independent variables. (Hair et al., 2019) and (Hair et al., 2011).

R2 values > 0.9 indicate the model is overfit, values > 0.75 indicate substantial fit, and values > 0.5 indicate moderate fit. For our construct, Organizational Practices and Workforce Agility, we have R-square and R-square adjusted, indicating a moderate fit since our R2 values ranged from 0.318 to 0.415.

Table 19: Coefficient of Determination (R2)

	R-square	**R-square adjusted**
Organizational _Practices	0.321	0.318
Workforce _Agility	0.415	0.410

The Standardized root mean square residual (SRMR) is a measure of badness of fit commonly used in the context of evaluating latent variable models. For PLS-SEM, not acceptable range for SRMR has been given for model fit (Hair et al., 2019). For our model, the SRMR is 0.096.

PLS-SEM model validity checks using f2 Effect size results are listed in Table 20. F-square is a statistically significant path, which indicates that the path has an effect. f2> 0.35 indicates a large effect, f2 > 0.15 indicates a moderate effect, or f2>0.02 indicates a small effect (Sawilowsky, 2009) and (Hair et al., 2011). The value for f2 for Organizational practices -> Workforce_Agility was 0.039, which indicates a medium effect. The value for f2 for Psychological Empowerment -> Workforce_Agility was 0.317, which indicates a medium effect. The value for f2 for Psychological Empowerment -> Organizational Practices was 0.472, which indicates a large effect.

Table 20: F-Square Effect

	Organizational _Practices	**Psychological _Empowerment**	**Workforce _Agility**
Organizational _Practices			0.039
Psychological _Empowerment	0.472		0.317
Workforce _Agility			

Lastly, we reviewed Stone-Geisser's criterion (Q2) in Table 21, which is a blindfolding technique evaluating the capability of the model to predict the endogenous latent variables. When all values are positive, this indicates good predictive relevance (Hair et al., 2011).

Table 21: Stone-Geisser's Q2 Criterion

	Q^2predict
OP-I1	0.177
OP-I2	0.220
OP-I3	0.208
OP-IS1	0.146
OP-IS2	0.153
OP-IS3	0.124
OP-OLT2	0.116
OP-OLT3	0.157
OP-TW1	0.146
OP-TW2	0.193
OP-TW3	0.177
OP-TW4	0.137
OP-TW5	0.192
WA-P1	0.286
WA-P2	0.298
WA-P3	0.231
WA-P4	0.167
WA-P5	0.181
WA-P7	0.189

4.9 Hypothesis Testing Results

After performing the measurement model assessment, which reviewed the data provided by the outer loadings, Cronbach's Alpha, and Average Variance Extracted, the Variance Inflation Factors and concluded with a review of the Discriminant Validity values by reviewing the Heterotrait - Monotrait ratio (HTMT) Criterion and the Fornell-Larker Criterion. Since all values fell into acceptable ranges, a structural model assessment was performed reviewing the data by reviewing the coefficient of determination (R2), F-Square (f2) effect sizes, and Stone-Geisser's criterion **(**Q2). All values were within range for the model's predictive relevance. Therefore, we could utilize the SmartPLS software to complete the hypothesis testing utilizing SEM. We found that all three hypothesized model paths are statistically significant Table 22 and Figure 3: Final Structural Model.

- H1: Psychological _Empowerment significantly affects Organizational _Practices such as Organizational Learning and training (OP-OLT), Involvement (OP-I), Teamwork (OP-TW), and Information Sharing (OP-IS) at NASA KSC within the Engineering Department.
- H2: Organizational _Practices such as Organizational Learning & Training (OP-OLT), Involvement (OP-I), Teamwork (OP-TW), and Information Sharing (OP-IS) significantly affect workforce _Agility (PE -> WA) such as Proactivity (WA-P) at NASA KSC within the Engineering Department.
- H3: Psychological _Empowerment statistically significantly affects workforce _Agility (PE -> WA), such as Proactivity (WA-P) at NASA KSC within the Engineering Department.

Table 222: Hypothesis Testing Results

Hypothesized Path	Original sample	Sample mean	Standard deviation	T statistics	P values	Supported
Psychological Empowerment -> Organizational Practices	0.566	0.572	0.037	15.316	0.000	Yes
Organizational Practices -> Workforce Agility	0.183	0.184	0.061	3.012	0.003	Yes
Psychological Empowerment -> Workforce Agility	0.522	0.525	0.057	9.095	0.000	Yes

▪ .

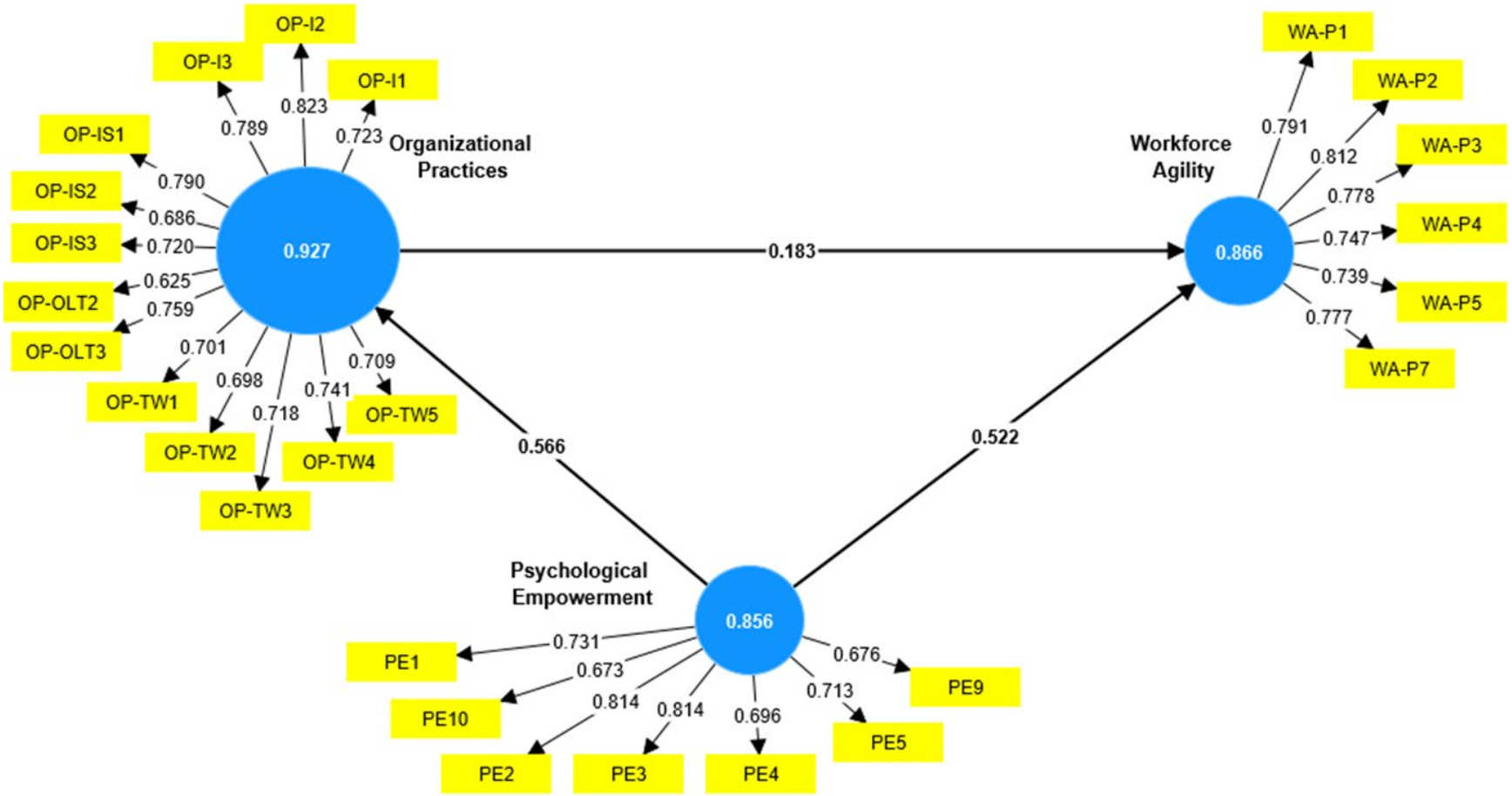


Figure 3: Final Structural Model

Figure 3: Final Structural Model

CHAPTER FIVE: CONCLUSION

5.1 Discussion

This study aimed to define workforce agility via a literature review and a conducted research survey of the NASA KSC engineering workforce. Then, by utilizing the survey results, determine the workforce agility of the NASA KSC engineering workforce and understand what has allowed the engineering workforce to transition from the Space Shuttle Program to the new Exploration Ground System (EGS) program. A secondary goal of this study was to identify and define agility characteristics at NASA KSC. The model developed in the study identified factors that influenced workforce agility. Because the model showed based on the values received, we can determine that since all items had outer loadings > 0.6 indicates, there is Indicator reliability (Gibson et al., 2022; Mohd Dzin & Lay, 2021), all the Cronbach's Alpha >.70, this indicates Indicator Reliability (Hair et al., 2019) and the Average Variance Extracted (AVE) > 0.5 that indicates Convergent Reliability (Hair et al., 2019) and lastly, all Composite reliability (CR) > 0.7 that indicates Internal Consistency (Aljuaid et al., 2022) and this allowed the hypotheses to be tested, resulting in the goals of this survey being achieved.

The model developed and utilized for this study defined several key agility characteristics found during the literature review. Utilizing the approved surveys, we surveyed the workforce to determine the fit of the model and provided data to rank the terms that have enabled this team to be agile.

When we look at the total effects of the hypotheses, we find that (H1) Psychological Empowerment -> Organizational Practices is supported by the data with the p-value of .000. Thus, Psychological Empowerment impacts organization practices such as organizational learning and training (OP-OLT), involvement (OP-I), teamwork (OP-TW), and information sharing (OP-IS).

(H2) Organizational Practices -> The data with the p-value of .003 support Workforce Agility Proactivity. Thus, organization practices such as organizational learning and training (OP-OLT), involvement (OP-I), teamwork (OP-TW), and information sharing (OP-IS) does impact Workforce Agility -proactivity within this study. This means that Organizational practices help initiate the activities that

contribute to organizational success and take the lead in pursuing promising opportunities (Muduli, 2017). Organizational learning and an organic structure characterized by decentralized decision-making, low formalization, and a flat structure can promote workforce agility (Alavi, Abd. Wahab, et al., 2014). Employee autonomy is one of the most critical determinants of workforce agility (Sherehiy & Karwowski, 2014).

And lastly, (H3) Psychological Empowerment -> Workforce Agility Proactivity is supported by the data with a p-value of .000. Thus, Psychological Empowerment impacts Workforce Agility Proactivity. It is essential for organizations to proactively identify and implement change when needed so they can move forward in becoming agile (Braun et al., 2017); when individuals are empowered, they have increased intrinsic task motivation manifested in four cognitions that reflect an individual's orientation to his or her work role: meaningfulness, competence, self-determination, and impact (Muduli & Pandya, 2018).

From the study, we can state that NASA's agility characteristics are psychological empowerment, organizational practices such as organizational learning and training (OP-OLT), involvement (OP-I), teamwork (OP-TW), and information sharing (OP-IS), and Workforce agility Proactivity (WA-P)

The agility characteristics that NASA should pay attention to as they press to be an agile workforce are Workforce Agility – Adaptability (WA-A) and Workforce Agility -Resilience (WA-R). Since adaptive behavior requires professional flexibility, which is the ability to take on multiple responsibilities, shift quickly from one role to another, and work simultaneously on different tasks in different teams (Muduli, 2017; Sherehiy & Karwowski, 2014), and resilient behavior would provide the workforce a positive attitude regarding changes, new ideas, and technology; tolerance of uncertain and unexpected situations, differences in opinions, and approaches; and tolerance to stressful situations and coping with stress (Muduli, 2017; Sherehiy & Karwowski, 2014).

After reviewing and recognizing the workforce agility characteristics from this study, other industries can review NASA KSC's organizational practices and how they provide psychological empowerment to

impact Workforce Agility- Proactivity. NASA KSC would need to learn from other companies how to increase their adaptability and resilience to become a fully agile organization.

In recapping the benefits of an agile workforce, Dattero et al. (2017) if NASA KSC were to improve their adaptability and resilience for workforce agility, it would enable the organization to accelerate time to market and simplify the development processes.

5.2 Conclusions

This research study revealed that the NASA KSC engineering team has the appropriate organizational practices, psychological empowerment, and workforce agility to assist their workforce in being agile and shifting from program to program. The data for this study was obtained voluntarily from the NASA KSC Engineering workforce. The survey responses assessed the latent variables of this study based on each participant's perceptions. Responses may have been based on what everyone has experienced within the engineering organization and do not reflect the views or opinions of the entire workforce. Despite these limitations, the survey results did help to identify workforce agility characteristics. Past research has proven that psychological empowerment and organizational practices impact workforce agility (Muduli, 2013, 2016, 2017; Muduli & Pandya, 2018; R. Qin & D. Nembhard, 2015; Sherehiy, 2008; Sherehiy & Karwowski, 2014; Suofi et al., 2014). Leaders within this organization should emphasize their support for improving workforce agility to increase their adaptability and resilience to enable the organization to become fully agile.

Improving on these factors may enable the organization to accelerate time to market and simplify the development processes.

In the future, we could review the data according to the generations to understand how the different generations respond to workforce agility within NASA KSC engineering and how to improve the characteristics at NASA KSC within engineering and other departments.

For this dissertation, I have met my goals and objectives and contributed to the body of knowledge by Developing and providing a framework for assessing workforce agility within the aerospace industry and

performing an assessment of the NASA KSC engineering workforce agility. A publication was submitted to MDPI – Applied Sciences, titled: Understanding Workforce Agility at NASA Kennedy Space Center, with authors Ledlyne Vazquez, Waldemar Karwowski, Gulsah Hancerliogullari Koksalmis, Timothy Kotnour, Luis Rabelo, and Piotr Mikusinski. In the future, I'd like to perform future studies to Understand workforce agility at NASA KSC within the Research & Technology Department and Understand workforce agility among the various generations of the workforce at NASA KSC.

APPENDIX A: NASA IRB APPROVAL AND CLOSURE

NASA Institutional Review Board (IRB)
2400 NASA Parkway
Houston, TX 77058
https://eirb.jsc.nasa.gov/
https://irb.nasa.gov/

NOTIFICATION OF EXEMPT DETERMINATION

May 31, 2022

TO: Ledlyne Vazquez

3218611044
Ledlyne.Vazquez@nasa.gov

FROM: Marisa Covington, Ph.D.
Chair, NASA Institutional Review Board

TITLE: Understanding Workforce Agility at NASA Kennedy Space Center post Space Shuttle Program

Study eIRB Number:	STUDY00000442
Method of Review:	Exempt
Type of Review:	Initial Study
IRB Disposition:	Approved
Determination Date:	5/31/2022
Risk Level:	No greater than minimal risk
FWA Number:	00019876

- The NASA IRB has determined that this protocol meets the criteria for Exempt review per 14 CFR 1230.104(d).
- **Investigators are responsible for updating their Conflict of Interest forms annually within the eIRB and maintaining active CITI training certificates.**
    - A MOD should be submitted to the e-IRB annually to attach the updated COI forms and CITI certificates.
- Exempt research protocols expire 5 years following the initial determination. If a Principal Investigator (PI) wishes to continue an exempt project beyond 5 years they are required to request re-certification prior to the expiration date.
- The protocol is exempt and no continuing review is needed.
- Minor changes as defined in HRP – 420 – SOP that do not impact risk or alter the exempt status may be made without prior IRB review. However, if any other changes are made to the protocol, a modification must be submitted to the NASA IRB for review.

- If there are questions about whether IRB review is needed, please submit a modification by selecting "Create Modification / CR" within the study. The IRB will examine the modifications and determine if the proposed changes will alter the exempt status of the protocol.

- The Investigator must report any adverse events or unexpected problems (UPIRSOs) resulting from this study to the NASA IRB, sponsor/funding source, and the Safety Office (if applicable).
- Once all research activities are complete, a request for study closure should be made in the eIRB.

The Principal Investigator remains responsible for following all pertinent ethical and legal guidelines as well as NASA policies.

The proposal was reviewed and determined to be exempt by the NASA IRB in accordance with ethical standards and the requirements of the Code of Federal Regulations on the Protection of Human Subjects (NASA 14CFR1230, HHS 45CFR46, and, if applicable, FDA 21CFR50 and 56).

Sincerely,

Marisa Covington, Ph.D., CIP
Chair, NASA IRB

NASA Institutional Review Board (IRB)
2400 NASA Parkway
Houston, TX 77058
https://eirb.jsc.nasa.gov/
https://irb.nasa.gov/

NOTIFICATION OF STUDY CLOSURE
16Oct2023

TO: Ledlyne Vazquez
3218611044
Ledlyne.Vazquez@nasa.gov

FROM: Marisa Covington, Ph.D., CIP
Chair, NASA Institutional Review Board

TITLE: Study Closure for Understanding Workforce Agility at NASA Kennedy Space Center post Space Shuttle Program

Study eIRB Number	CR00000784
Type of Review:	Expedited Review (mm)
IRB Disposition:	Closed – All study activities completed
Date of Closure:	16Oct2023
FWA Number:	00019876

This letter confirms that a study closure for Understanding Workforce Agility at NASA Kennedy Space Center post Space Shuttle Program has been processed through the e-IRB system as "Closed-all study activities completed."

The Principal Investigator must report to the NASA IRB Office any information learned after study closure that could affect subject safety or medical care, including but not limited to, serious adverse events or unanticipated problems reported by the Sponsor or others responsible for study monitoring.

All signed informed consent forms must be maintained by the Principal Investigator for at least three years after study closure.

Sincerely,

Marisa Covington, Ph.D., CIP
Chair, NASA IRB

APPENDIX B: UCF IRB APPROVAL AND CLOSURE

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138, IRB00012110
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

EXEMPTION DETERMINATION

May 19, 2022

Dear Ledlyne Vazquez:

On 5/19/2022, the IRB determined the following submission to be human subjects research that is exempt from regulation:

Type of Review:	Initial Study, Initial Study
Title:	Understanding Workforce Agility at NASA Kennedy Space Center post Space Shuttle Program
Investigator:	Ledlyne Vazquez
IRB ID:	STUDY00003731
Funding:	None
Grant ID:	None
Documents Reviewed:	• Workforce_Agility_NASA-KSC_CandidacyExam_Ledlyne Vazquez _ Oct16.pptx, Category: Faculty Research Approval; • Financial Conflicts, Category: Other; • HRP 254 , Category: Consent Form; • HRP 255 Form, Category: IRB Protocol; • Microsoft Forms Survey Questionnaire, Category: Survey / Questionnaire; • Recruitment Email, Category: Recruitment Materials

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made, and there are questions about whether these changes affect the exempt status of the human research, please submit a modification request to the IRB. Guidance on submitting Modifications and Administrative Check-in are detailed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system. When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Jonathan Coker
Designated Reviewer

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138, IRB00012110
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

CLOSURE

August 29, 2023

Dear Ledlyne Vazquez:

On 8/29/2023, the IRB reviewed the following protocol:

Type of Review:	Continuing Review
Title:	Understanding Workforce Agility at NASA Kennedy Space Center post Space Shuttle Program
Investigator:	Ledlyne Vazquez
IRB ID:	CR00002492
Funding:	None, None *<Indicate "None" if there is none.>*
IND, IDE, or HDE:	None *<Indicate "None" if there is none.>*

The IRB acknowledges your request for closure of the protocol effective as of 8/29/2023. As part of this action:

- The protocol is permanently closed to enrollment.
- All subjects have completed all protocol-related interventions.
- Collection of private identifiable information is completed.
- Analysis of private identifiable information is completed.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Yariela Thompson
UCF IRB

APPENDIX C: SURVEY INSTRUMENT

Workforce Agility Survey

* Required

1. ELECTRONIC CONSENT: Please select your choice below.

   Clicking on the "agree" button below indicates that:

   - you have read the attached IRB information
   - you voluntarily agree to participate in this survey
   - you are at least 18 years of age

   If you do not wish to participate in the research survey, please decline participation by clicking on the "disagree" button and exit the survey. *

   - [ ] Agree
   - [ ] Disagree

2. How are you affiliated with NASA? *

   - [ ] NASA Civil Servant
   - [ ] Contractor Employee
   - [ ] Prefer not to Answer

3. What is your Gender? *

   - [ ] Male
   - [ ] Female
   - [ ] Prefer not to Answer

4. What is your current role? *

   - [ ] Chief Engineer
   - [ ] Systems Engineering & Integration
   - [ ] Project Manager
   - [ ] Sub-system or Component Level Engineer
   - [ ] Engineering Analyst
   - [ ] Engineering Manager
   - [ ] Design Engineer
   - [ ] Operations Engineer
   - [ ] Test Engineer
   - [ ] Engineering Support Personnel
   - [ ] Prefer not to Answer
   - [ ] Other

5. Which NASA Programs have you supported? *

- [ ] Commercial Crew
- [ ] International Space Station
- [ ] Space Shuttle
- [ ] EGS/Artemis/Constellation
- [ ] HLS/Gateway
- [ ] Research & Technology
- [ ] Launch Services
- [ ] Other

6. At which NASA Center do you work? *

- ◯ Ames Research Center (ARC)
- ◯ Glenn Research Center (GRC)
- ◯ Goddard Space Flight Center (GSFC)
- ◯ Jet Propulsion Laboratory (JPL)
- ◯ Johnson Space Center (JSC)
- ◯ Kennedy Space Center (KSC)
- ◯ Langley Research Center (LaRC)
- ◯ Marshall Space Flight Center (MSFC)
- ◯ NASA Headquarters (HQ)
- ◯ Stennis Space Center (SSC)
- ◯ Other

7. How many years have you worked in the Aerospace Industry? *

- [ ] <5 years
- [ ] 6-10 years
- [ ] 11-19 years
- [ ] 20-29 years
- [ ] 30-39 years
- [ ] >40 years

8. My organization encourages and facilitates learning and training to enhance my adaptability and flexibility in the changing environment. *
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Neither Agree nor Disagree
   - [ ] Agree
   - [ ] Strong Agree

9. My organization systematically lays out individuals' training requirements. *
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Neither Agree nor Disagree
   - [ ] Agree
   - [ ] Strong Agree

10. My organizational culture makes employee learning a top priority. *
    - [ ] Strongly Disagree
    - [ ] Disagree
    - [ ] Neither Agree nor Disagree
    - [ ] Agree
    - [ ] Strong Agree

11. My organization encourages me to work in teams. *
    - [ ] Strongly Disagree
    - [ ] Disagree
    - [ ] Neither Agree nor Disagree
    - [ ] Agree
    - [ ] Strong Agree

12. My organization promotes internal teamwork. *
    - [ ] Strongly Disagree
    - [ ] Disagree
    - [ ] Neither Agree nor Disagree
    - [ ] Agree
    - [ ] Strong Agree

13. My organization encourages external teamwork. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

14. My organization promotes intragroup teamwork. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

15. My organization encourages cross-functional teamwork. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

16. Management in my organization encourages input and feedback from employees, especially on decisions that affect employee services and well-being. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

17. Employees in my organization are encouraged to involve in decision- making. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

18. Employees in my organization are given opportunities to be involved in decision-making. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

19. My organization encourages frequent organizational conversation that keeps alive the lessons learned from history. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

20. My organization promotes specific mechanisms for sharing lessons learned in organizational activities from department to department (unit to unit, team to team). *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

21. Top management repeatedly emphasizes the importance of knowledge sharing in my organization. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

22. The work I do is very important to me. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

23. My job activities are personally meaningful to me. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

24. The work I do is meaningful to me. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

25. I am confident about my ability to do my job. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

26. I am self-assured about my capabilities to perform my work activities. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

27. I have mastered the skill necessary to perform my job. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

28. I can decide on my own how to go about doing my work. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

29. I have considerable opportunity for independence and freedom in how I do my job. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

30. My impact on what happens in my department is large. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

31. I have significant influence over what happens in my department. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

32. I am able to solve new and complex problems at work. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

33. I address difficulties in my tasks before they become major problems. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

34. I look for the opportunities to make improvements at work. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

35. When I see something that I do not like, I am trying to fix it. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

36. I am trying to find out more effective ways to perform my job. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

37. I design new procedures or processes for my work area. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

38. I am trying to think "outside the box" in order to solve problems. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

39. I find new ways to obtain or utilize resources when resources are insufficient to do my job. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

40. I am reluctant to accommodate and incorporate changes into my work. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

41. I like to change old way of doing things. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

42. I am tolerant to situations where things seems confusing. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

43. I am able to work out what to do when work instructions are unclear. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

44. I remain calm and composed when faced with difficult circumstances. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

45. I am able to perform my job efficiently in difficult or stressful situations. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

46. I am able to work well when faced with a demanding workload or schedule. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

47. When a difficult situation occurs, I react by trying to manage the problem. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

48. I drop everything and take an alternate course of action to deal with an urgent problem. *

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neither Agree nor Disagree
- [ ] Agree
- [ ] Strong Agree

49. How easy or difficult is it for you to change your behavior to work more effectively with other people? *

- [ ] Extremely Difficult
- [ ] Somewhat Difficult
- [ ] Neutral - Neither Easy or Difficulty
- [ ] Somewhat Easy
- [ ] Extremely Easy

50. How easy or difficult is it for you to accept critical feedback? *

- [ ] Extremely Difficult
- [ ] Somewhat Difficult
- [ ] Neutral - Neither Easy or Difficulty
- [ ] Somewhat Easy
- [ ] Extremely Easy

51. How easy or difficult is it for you to communicate well with people of different backgrounds? *

- [ ] Extremely Difficult
- [ ] Somewhat Difficult
- [ ] Neutral - Neither Easy or Difficulty
- [ ] Somewhat Easy
- [ ] Extremely Easy

52. How quickly or slowly do you learn new knowledge or skills needed to use new equipment at work? *

- [ ] Extremely Quickly
- [ ] Somewhat Quickly
- [ ] Neutral - Neither Slow or Quick
- [ ] Somewhat Slow
- [ ] Extremely Slow

53. How quickly or slowly do you learn new knowledge or skills needed to keep up-to-date at work? *

- [ ] Extremely Quickly
- [ ] Somewhat Quickly
- [ ] Neutral - Neither Slow or Quick
- [ ] Somewhat Slow
- [ ] Extremely Slow

54. How quickly or slowly do you learn new knowledge or skills needed perform new tasks at work? *

- [ ] Extremely Quickly
- [ ] Somewhat Quickly
- [ ] Neutral - Neither Slow or Quick
- [ ] Somewhat Slow
- [ ] Extremely Slow

55. How quickly or slowly do you learn new knowledge or skills needed to use new equipment at work? *

- [ ] Extremely Quickly
- [ ] Somewhat Quickly
- [ ] Neutral - Neither Slow nor Quickly
- [ ] Somewhat Slow
- [ ] Extremely Slow

56. How easy or difficult is it for you to adjust to new work procedures? *

- [ ] Extremely Difficult
- [ ] Somewhat Difficult
- [ ] Neutral - Neither Easy or Difficulty
- [ ] Somewhat Easy
- [ ] Extremely Easy

57. How quickly or slowly do you learn new knowledge or skills needed perform new tasks at work? *

- [ ] Extremely Quickly
- [ ] Somewhat Quickly
- [ ] Neutral - Neither Slow or Quick
- [ ] Somewhat Slow
- [ ] Extremely Slow

58. How quickly or slowly do you adjust to switching from one project to another? *

- [ ] Extremely Quickly
- [ ] Somewhat Quickly
- [ ] Neutral - Neither Slow or Quick
- [ ] Somewhat Slow
- [ ] Extremely Slow

59. How quickly or slowly do you adjust to changing your way of doing things to suit co-workers who have different ways of performing a job? *

- [ ] Extremely Quickly
- [ ] Somewhat Quickly
- [ ] Neutral - Neither Slow or Quick
- [ ] Somewhat Slow
- [ ] Extremely Slow

60. How quickly or slowly do you adjust to changing plans when the necessary supplies or equipment are suddenly unavailable? *

- [ ] Extremely Quickly
- [ ] Somewhat Quickly
- [ ] Neutral - Neither Slow or Quick
- [ ] Somewhat Slow
- [ ] Extremely Slow

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