2023

Affordability culture in organizations

Taylor Yeazitzis

Follow this and additional works at: https://louis.uah.edu/uah-theses

Recommended Citation

This Thesis is brought to you for free and open access by the UAH Electronic Theses and Dissertations at LOUIS. It has been accepted for inclusion in Theses by an authorized administrator of LOUIS.
AFFORDABILITY CULTURE IN ORGANIZATIONS

Taylor Yeazitzis

A THESIS

Submitted in partial fulfillment of the requirements
for the degree of Master of Arts
in
Psychology
to
The Graduate School
of
The University of Alabama in Huntsville
August 2023

Approved by:

Dr. Kristin Weger, Research Advisor and Committee Chair
Dr. Jodi Price, Committee Member
Dr. Bryan Mesmer, Committee Member
Dr. Carolyn Sanders, Department Chair
Dr. Sean Lane, College Dean
Dr. Jon Hakkila, Graduate Dean
Abstract

AFFORDABILITY CULTURE IN ORGANIZATIONS

Taylor Yeazitzis

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts

Psychology

The University of Alabama in Huntsville
August 2023

Affordability has been a growing interest in organizations over the years. Though affordability is an ever-present issue within organizations, there is a lack of research surrounding affordability culture as an organizational subculture. The current study aims to close this research gap by identifying organizational aspects associated with affordability in which current organizational practices can be evaluated by organization members. To accomplish this goal, 346 participants from NASA, industry, and The University of Alabama in Huntsville were surveyed to understand the organizational aspects associated with affordability. Results indicated that students tended to evaluate affordability in terms of budgets and funding, whereas NASA and industry respondents tended to evaluate affordability in terms of the organizational behaviors associated with affordability. Results from this study can be used to inform organizations of employee perceptions regarding current organizational behavior related to affordability.
Acknowledgements

This work was supported by NASA’s Exploration Systems Development Mission Directorate through the Space Launch System (SLS) Program Liquid Engines Project.
# Table of Contents

Abstract ............................................................................................................. ii

Acknowledgements ........................................................................................... iv

Table of Contents ............................................................................................... v

List of Figures ........................................................................................................ x

List of Tables ......................................................................................................... xii

Chapter 1. Introduction ......................................................................................... 1

Chapter 2. Background ......................................................................................... 4

2.1 Affordability ................................................................................................. 4

2.2 Organizational Culture .................................................................................. 8

2.3 Organizational Climate ................................................................................ 12

2.4 Safety Culture to Inform Affordability Culture ............................................. 13

2.5 Organizational Behaviors of Affordability to Inform Affordability Culture .......................... 15

2.6 Organizational Components of Interest for Affordability ......................... 18

2.6.1 Organizational Goals ............................................................................... 19

2.6.2 Communication and Working Relationships .......................................... 20

2.6.3 Planning and Scheduling ....................................................................... 22

2.6.4 Roles and Responsibilities .................................................................... 23

2.6.5 Engineering Processes .......................................................................... 25

2.6.6 Budgetary Aspects ................................................................................ 27

2.7 Research Objective ...................................................................................... 29

Chapter 3. Method .......................................................................................... 34

3.1 Participants .................................................................................................. 34
3.2 Materials .................................................................................. 35
3.3 Development of Affordability Survey ............................... 35
   3.3.1 Open-Ended Questions ................................................. 36
   3.3.2 Organizational Climate Measure (OCM) ................. 37
   3.3.3 Project Organizational Culture Framework (POCF) .... 37
   3.3.4 Original Questions Generated for Survey ............... 38
   3.3.5 Demographics .............................................................. 38
3.4 Procedure ............................................................................... 39
3.5 Statistics ............................................................................... 39
   3.5.1 Qualitative Analysis: Affordability Definitions ........ 40
   3.5.2 Qualitative Analysis: Generation of Coding Schemes ... 41
   3.5.3 Qualitative Analysis: Singular Organization
       Comparison of Code Frequencies .................................... 44
   3.5.4 Qualitative Analysis: Between-Group Comparison
       of Code Frequencies .......................................................... 44
   3.5.5 Quantitative Analysis: Affordability Groupings ........ 45
   3.5.6 Quantitative Analysis: Internal Consistency
       of Affordability Groupings ................................................. 47
   3.5.7 Quantitative Analysis: NASA Within-Group
       Agreement ........................................................................ 48
   3.5.8 Quantitative Analysis: NASA Between-Group
       Comparison ...................................................................... 49
   3.5.9 Quantitative Analysis: NASA, Industry, and Student
       Between-Group Comparison .............................................. 50
   3.5.10 Frequency Counts of Likert Data .............................. 51

Chapter 4. Results ........................................................................ 52
Appendix C. Organizational Climate Scale .................................................. 115
Appendix D. Project Organizational Culture Framework ............................. 120
Appendix E. Demographic Questions .......................................................... 123
Appendix F. Budgetary Aspects Analyses .................................................... 124
Appendix G. Affordability Grouping Frequency Counts ............................... 128
List of Figures

Figure 2.1 Competing Values Framework Diagram .................................................. 11
Figure 2.2 Organizational Components of an Affordability Culture ....................... 19
Figure 3.1 Thematic Analysis Process for Qualitative Statistics ............................... 42
Figure 3.2 Thematic Analysis Process for Quantitative Statistics ......................... 46
Figure 4.1 Affordability Definitions Given by NASA, Industry, and Students .......... 54
Figure 4.2 Affordability Improvement Responses .................................................. 57
Figure 4.3 Cultural Wants Responses ...................................................................... 58
Figure 4.4 Cultural Barriers Responses .................................................................. 60
Figure 4.5 Affordability Improvement Response Distribution for NASA, Industry, and Students ................................................................. 61
Figure 4.6 Cultural Wants Response Distribution for NASA, Industry, and Students ................................................................. 62
Figure 4.7 Cultural Barriers Response Distribution for NASA, Industry, and Students ................................................................. 63
Figure 4.8 Median Rating for Budgetary Aspects of Affordability Grouping per Years at NASA ................................................................. 73
Figure 4.9 Distribution of Responses to Budgetary Aspects of Affordability Questions by Years at NASA ................................................................. 74
Figure 4.10 Significant Efficiency in Processes Questions ........................................ 78
Figure 4.11 Significant Budgetary Aspects of Affordability Questions ................... 81
Figure 5.1 Significant Organizational Components of an Affordability Culture ....... 91
Figure F.1 Median Rating for Question: “Your program is likely to experience cost overruns.” .................................................................................. 125
Figure F.2 Median Rating for Question: “Your program rarely stays within its fiscal year budget.” .................................................................................. 126
Figure G.1 Distribution of NASA Responses for Clarity of Organizational Goals Questions ................................................................. 128

Figure G.2 Distribution of NASA Responses for Efficiency in Communication Questions ............................................................... 129

Figure G.3 Distribution of NASA Responses for Effective Working Relationships Questions .............................................................. 129

Figure G.4 Distribution of NASA Responses for Efficiency in Planning and Scheduling Questions ..................................................... 130

Figure G.5 Distribution of NASA Responses for Clarity of Roles and Responsibilities Questions ......................................................... 131

Figure G.6 Distribution of NASA Responses for Efficiency in Processes Questions ............................................................................. 132

Figure G.7 Distribution of NASA Responses for Budgetary Aspects of Affordability Questions ........................................................... 132

Figure G.8 Distribution of Student Responses for Clarity of Organizational Goals Questions .............................................................. 133

Figure G.9 Distribution of Student Responses for Efficiency in Communication Questions ............................................................................. 134

Figure G.10 Distribution of Student Responses for Effective Working Relationships Questions ................................................................. 134

Figure G.11 Distribution of Student Responses for Efficiency in Planning and Scheduling Questions ..................................................... 135

Figure G.12 Distribution of Student Responses for Clarity of Roles and Responsibilities Questions ......................................................... 136

Figure G.13 Distribution of Student Responses for Efficiency in Processes Questions ............................................................................. 137

Figure G.14 Distribution of Student Responses for Budgetary Aspects of Affordability Questions ........................................................... 137

Figure G.15 Distribution of Industry Responses for Clarity of Organizational Goals Questions .............................................................. 138
Figure G.16 Distribution of Industry Responses for Efficiency in Communication Questions ................................................................. 139

Figure G.17 Distribution of Industry Responses for Effective Working Relationships Questions ................................................................. 139

Figure G.18 Distribution of Industry Responses for Efficiency in Planning and Scheduling Questions ................................................................. 140

Figure G.19 Distribution of Industry Responses for Clarity of Roles and Responsibilities Questions ................................................................. 141

Figure G.20 Distribution of Industry Responses for Efficiency in Processes Questions ................................................................. 142

Figure G.21 Distribution of Industry Responses for Budgetary Aspects of Affordability Questions ................................................................. 142
List of Tables

Table 2.1 Affordability Definitions Across Industries ........................................ 5
Table 2.2 Affordability Definitions Across the Aerospace Industry .................. 7
Table 2.3 Contrasting Characteristics of Organizational Climate and Culture ....... 13
Table 2.4 Research Questions and Hypotheses ................................................. 33

Table 3.1 Open-Ended Affordability Survey Questions .................................... 36
Table 3.2 Affordability Improvement Codes ..................................................... 43
Table 3.3 Cultural Wants Codes ................................................................. 43
Table 3.4 Cultural Barriers Codes ............................................................... 44
Table 3.5 Affordability Groupings and Definitions ......................................... 47

Table 4.1 Cronbach’s Alpha per Affordability Group ..................................... 66
Table 4.2 Interrater Agreement Estimates per NASA Job Category ................. 68
Table 4.3 Independent Samples Comparison of Affordability Aspects by Job Category ......................................................... 69
Table 4.4 Interrater Agreement Estimates per Years at NASA Category ............ 70
Table 4.5 Independent Samples Comparison of Affordability Aspects by Years at NASA ................................................................. 72
Table 4.6 Independent Samples Comparison of Likert Ratings for NASA, Industry, and Students ................................................................. 76
Table 4.7 Individual Questions with Significant Group Differences ................. 77
Table 4.8 Mean Rank Differences for Process Questions ............................... 80
Table 4.9 Mean Rank Differences for Budgetary Aspects Questions ............... 82
Table B.1 Affordability Survey Question Sources ........................................... 112
Table F.1 Independent Samples Comparison by Years at NASA per Budgetary Aspects of Affordability Questions ........................................ 125
Chapter 1. Introduction

The effects of organizational culture and climate have been researched to understand how they impact the way an organization develops and operates. Culture can be defined as a pattern of shared tacit assumptions that are learned by a group as it solves problems of external adaptations and internal integration (Schein, 1990). These assumptions are passed along to new members of the organization as the standard way to think, behave, and feel. Behavioral norms and values held by organization members lay the basis for organizational culture to form. These behavioral norms in turn drive the performance of an organization (Balthazard et al., 2006). Previous research has shown that organizational culture may have implications for the success of employee training within an organization (Ballesteros et al., 2012), employee attitudes during a merge (Febriani & Yancey, 2019), and overall organizational performance (Prajogo & McDermott, 2011).

Existing within an organizational culture are subcultures, defined by Van Maanen and Barley (1984) as a subset of an organization’s members who interact regularly with one another, identify themselves as a distinct group within the organization, share a set of problems commonly defined to be the problems of all, and routinely take action on the basis of collective understandings unique to the group. An example of an organizational subculture previously studied in literature is safety culture, wherein the overall goal within the subculture is to increase safe practices within an organization (Cooper, 2000).
In a similar fashion to the prioritization of safety in organizations, affordability has also been an area of increasing interest over the years. An example of this interest in affordability can be seen in the post-Apollo era at NASA, where cost reduction without sacrificing performance was a directive within projects. During the peak of the Apollo era, NASA was allotted 4.41% of the federal budget (Johnson, 2006) which to date is the highest budget percentage the organization has seen. Following this era of missions, costs of projects as well as schedules became excessive and unmanageable, leading to a period between 1978 and 1989 where no planetary missions were launched (Frank, 2019). In 1992, the Faster, Better, Cheaper approach began at NASA, where cost reduction was enacted through the use of microtechnologies to minimize both spacecraft size and cost as well as the use of organizational restructuring by way of downsizing to reduce the number of people involved in a project and the time required to develop missions. The Faster, Better, Cheaper era of NASA came to an end in 1999 when four out of five projects failed in flight, with critics suggesting this paradigm was attacked as being “too much, too cheap, too soon” (McCurdy, 2001). This challenge to balance cost and performance is not unique to NASA and continues to be an issue many organizations face today.

Despite this continued interest in affordable practices, there is no uniform understanding of what an affordability culture means in an organization. Organizations may desire to adhere to affordable practices but do not know what core attributes within an organization contribute to a culture that conducts themselves with affordability at the forefront. In the way that safety culture was first discussed following the Chernobyl nuclear reactor disaster in 1986 and then later integrated into industry practices,
organizations could benefit from the creation of an affordability culture with affordable practices enacted through behaviors and choices in everyday task activities.
Chapter 2. Background

2.1 Affordability

Affordability within industry is a topic that has grown in importance over the last several decades. Some researchers have even nicknamed affordability as “The Next Frontier,” emphasizing the importance that affordability will play in industry in the future (Towse & Mauskpof, 2018). Affordability has been an area of interest in various industries, such as the defense industry (Bankole et al., 2009; Kroshl & Pandolfini, 2000), the aircraft industry (Mavris & DeLaurentis, 1998), and the aerospace industry among others (Emmons et al., 2010; Marsh, 2001). One issue in the study of affordability is that there is no cohesive definition of affordability. Affordability definitions can be found within a number of industries, though they all seem to define affordability in differing ways (see Table 2.1). Understanding approaches to affordability is therefore complicated by differing, sometimes even conflicting, perceptions of what affordability actually means within an organization. Some organizations have defined affordability in terms of financial burden thresholds (Litman, 2017; Moodie-Dyer, 2011; Temple, 2008) whereas others define it in terms of cost ratio (West et al., 2015) and others as value (Bever & Collofello, 2002).
Table 2.1 Affordability Definitions Across Industries. This table shows various definitions of affordability across numerous industry types, including transportation, healthcare, childcare, housing, and software (Falcon et al., 2022).

<table>
<thead>
<tr>
<th>Industry</th>
<th>Definition</th>
<th>Key Concept</th>
<th>Citing Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>“Transportation affordability refers to the financial burden households bear in purchasing transportation services, particularly those required to access basic goods and activities (healthcare, shopping, school, work and social activities).”</td>
<td>Financial burden threshold on household</td>
<td>Litman, 2017</td>
</tr>
<tr>
<td>Healthcare</td>
<td>“We define as affordable for a given country an intervention for which the ICER [incremental cost-effectiveness ratio] was less than the per capita gross domestic product (GDP).”</td>
<td>Ratio between ICER and GDP</td>
<td>West et al., 2015</td>
</tr>
<tr>
<td>Childcare</td>
<td>“A sliding fee scale for copayments must be established on the basis of income (federal guidelines define 10 percent of income as a benchmark for affordability)”</td>
<td>Financial burden threshold on household</td>
<td>Moodie-Dyer, 2011</td>
</tr>
<tr>
<td>Housing</td>
<td>“Traditionally, housing affordability is measured using the share of housing costs out of current income”</td>
<td>Financial burden threshold on household</td>
<td>Temple, 2008</td>
</tr>
<tr>
<td>Software</td>
<td>“The concept of affordability focuses on analytically determining the “best value” of a system by examining multivariate attributes. The fact that a system costs less does not mean that it will be more affordable.”</td>
<td>Best value</td>
<td>Bever &amp; Collofello, 2002</td>
</tr>
</tbody>
</table>
One interesting phenomenon found throughout the evaluation of affordability definitions is the lack of cohesiveness across industries and within similar industries. As seen in Table 2.2, affordability definitions within the aerospace industry range from concepts such as lifecycle cost ratios (Bankole et al., 2009) to feasibility (Wu et al., 2014) in addition to a number of various other concepts.
Table 2.2 Affordability Definitions Across the Aerospace Industry. This table shows various affordability definitions within the aerospace industry (Falcon et al., 2022).

<table>
<thead>
<tr>
<th>Definition</th>
<th>Key Concept</th>
<th>Citing Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Affordability is the ‘degree to which the Whole Life Cycle Cost (WLCC) of an individual project or program is in consonance with the long range investment capability and evolving customer requirement’”</td>
<td>Ratio between Whole Life Cycle Cost and investment capability</td>
<td>Bankole et al., 2009</td>
</tr>
<tr>
<td>“Program Affordability equates to developing a long-term strategy that will meet critical objectives while remaining within NASA’s budget”</td>
<td>Critical objectives while within budget</td>
<td>Emmons et al., 2010</td>
</tr>
<tr>
<td>“The total program cost benefits of allowing life cycle cost sensitivity analysis to drive the conceptual design development, and how the user can more effectively motivate the contractor to optimize his design for supportability and affordability”</td>
<td>Cost benefits</td>
<td>Daugherty, 1989</td>
</tr>
<tr>
<td>“By defining affordability as the property of becoming or remaining feasible relative to resource needs and resource constraints over time, Multi-Attribute Tradespace Exploration and Epoch-Era Analysis can be used to find affordable solutions”</td>
<td>Feasibility</td>
<td>Wu et al., 2014</td>
</tr>
<tr>
<td>“The degree to which the life-cycle cost of an acquisition program is in consonance with the long-range investment and force structure plans”</td>
<td>Long term sustainability Life cycle cost</td>
<td>Defense Acquisition Guidebook, 2013</td>
</tr>
</tbody>
</table>

As there is no singular definition utilized in affordability research, many differing approaches have been taken to access and evaluate affordable practices in organizations. Affordability within an organization has been evaluated in terms of value, priority, and budget (Towse & Mauskopf, 2018). Affordability has been assessed in the defense industry using a blend of interval cost estimation and cost-benefit analysis (Kroshl &
Pandolfini, 2000) as well as using an “indication of affordability” formula that takes into account budget, lifecycle cost, and spending ability (Bankole et al., 2012). In the aerospace industry, affordability has been analyzed as a measure of system feasibility and viability (Emmons et al., 2010) as well as in terms of achieving the best value as opposed to striving for the cheapest option (Marsh, 2001). Within research, affordability has typically taken a system design perspective into account, focusing on development, production, and maintenance processes (Armengaud et al., 2017). The system perspective is an important aspect of affordability, though it is not the only perspective. In order to establish an organizational culture around affordability, approaching affordability only in terms of systems engineering is too narrow. Organizational behaviors influenced by cultural norms relating to affordability should also be taken into consideration to understand affordability beyond solely a systems perspective.

2.2 Organizational Culture

In order to better understand how an affordability culture can be created, a literature review was conducted regarding the different types of organizational cultures that exist and the views and beliefs held by organizations that align with differing culture types. The concept of organizational culture can be simplified into the collective, shared assumptions often taken for granted that a group has learned throughout its history (Schein, 2009). Schein describes organizational culture in terms of basic underlying assumptions that define the fundamental values and beliefs of an organization.

Schein proposed a 3-level model to avoid oversimplification of an organizational culture as well as capture nuances within each stage. At the surface level of organizational culture are artifacts, or visible organizational structures and processes that
an individual becomes aware of while spending time within an organization. Examples of artifacts can be how organization members interact with one another, how formally or informally dressed members of an organization are, or how formally or informally meetings between members are conducted (Schein, 2009). Culture at this level is very clear as to how it is performed, but the reasoning why the members perform in such a way and why the organization is constructed in its specific manner are unclear. At the middle level are espoused values, or strategies, goals, and philosophies held by an organization. Within the espoused values level of culture, one has experienced artifacts and behavior patterns of an organization but must further understand the certain values held by the organization in order to create an image of the organization. At the deepest level of culture are underlying assumptions, or unconscious, taken-for-granted beliefs, perceptions, and thoughts that act as the ultimate source of values within an organization. Some examples of underlying assumptions are the national background of an organization, core technology underlying the business, and personalities of organization founders (Schein, 2009). Within this level of culture, jointly learned values and beliefs become taken for granted and seen as non-negotiable within the organization. Understanding organizational culture within the frame of the 3-level model proposed by Schein allows for differentiation between the levels in terms of how and why an organization performs in the manner that it does and what contributing factors exist within each level.

Cultures may be assessed to understand the current culture of an organization compared to the desired future culture of an organization. Understanding the culture of an organization may help determine whether certain individuals are a good fit for an
organization and vice versa. A prominent foundational theory for organizational culture is the competing values framework (CVF; Quinn & Rohrbaugh, 1983). In the CVF, organizations are examined in terms of the flexibility and focus of the organization, where organizations can fall on a spectrum of flexibility/discretion to stability/control as well as a spectrum of internal focus/integration and external focus/differentiation (Cameron, 2009; Quinn & Rohrbaugh, 1983).

Building off the CVF, four organizational cultures have been identified: clan, adhocracy, hierarchy, and market (Cameron & Quinn, 2011). Organizations that encourage collaborative efforts with an internal focus and flexibility align with clan organizational culture. This type of culture is enacted through group cohesion, participation, communication, and empowerment achieved through organizational morale, organizational development, and employee commitment. Organizations that may be flexible in their approaches can differ in terms of organizational focus. Whereas clan culture is a flexible culture with an internal focus, adhocracy culture is a flexible culture with an external focus. Organizations with an adhocracy culture emphasize adaptability, creativity, and agility. These organizations are often on the forefront of innovation, creating cutting edge output within their field. While some organizations prioritize creativity, others favor more stable approaches. Organizations that tend to have an internal focus and emphasize control within the organization align with hierarchy culture. Markers of hierarchy culture include capable processes, consistency, process control, and measurement. These markers can be seen through efficiency within the organization, timeliness on goals and deliverables, as well as smooth functioning within the organization and the members that make up the organization. The final culture type
proposed by CVF is market culture. Market culture is an externally focused culture that is considered stable and values control. The aim of market culture is to compete through customer focus and satisfaction, productivity, and enhancing competitiveness through means of organizational development. The goals of an organization with market culture are to increase market share, profitability, and achieve goals. For a visual summation of each culture type, see Figure 2.1.

**STRUCTURE: FLEXIBLE**

<table>
<thead>
<tr>
<th>FOCUS: INTERNAL</th>
<th>CLAN</th>
<th>ADHOCRACY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal: collaboration</td>
<td>Goal: creation</td>
<td></td>
</tr>
<tr>
<td>Strategies: commitment, communication, development</td>
<td>Strategies: innovation, transformation, agility</td>
<td></td>
</tr>
<tr>
<td>Theory: human development and participation</td>
<td>Theory: innovation, vision, and usage of new resources</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FOCUS: EXTERNAL</th>
<th>HIERARCHY</th>
<th>MARKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal: control</td>
<td>Goal: competition</td>
<td></td>
</tr>
<tr>
<td>Strategies: efficiency, timeliness, uniformity</td>
<td>Strategies: marketability, goal achievement, profitability</td>
<td></td>
</tr>
<tr>
<td>Theory: control through capable processes</td>
<td>Theory: aggressive competition and customer focus</td>
<td></td>
</tr>
</tbody>
</table>

**STRUCTURE: STABLE**

*Figure 2.1* Competing Values Framework Diagram. This figure shows how the Competing Values Framework lays the foundation for organizational cultures to exist. This figure was adapted from Hartnell et al., 2011.

Previous research done by Hartnell and colleagues (2011) utilized the CVF to align organizational culture with an operation strategy in order to improve innovation.
outcomes. In this study, the researchers noted that the CVF has been used to analyze culture in over 10,000 organizations globally. Hartnell and colleagues (2019) later expanded on their previous research to evaluate organizational culture and predictive validity on organizational outcomes. As seen by previous research, the CVF has been frequently used to analyze and understand the culture within an organization. In terms of affordability, culture may be assessed to understand wasteful practices currently taking place within an organization, or how best to adapt norms, values, and beliefs with affordability as an organizational goal. Evaluating current affordable practices, or lack thereof, in an organization may highlight areas of improvement where practices and approaches can be altered to emphasize an affordability culture.

2.3 Organizational Climate

Organizational climate is often discussed in association with organizational culture, and though these constructs are similar, there are distinguishing differences between the two. Perceptions of the work environment are often taken into consideration during the evaluation of an organization’s culture and these perceptions are commonly known as organizational climate (Rosseau, 1988). Whereas organizational culture is concerned with shared assumptions and values of an organization, organizational climate is concerned with the day-to-day environment and perceptions of behavior (Hoy, 1990). For further differences between constructs, see Table 2.3. Organizational climate is often understood as an intervening variable between an organization and the behavior of its members as a way to understand how employees experience organizations (Patterson et al., 2005). Organizational climate has been broken down into sub-climates such as safety climate (Zohar, 2000), service climate (Susskind et al., 2003), justice climate (Colquitt,
2001), and leadership (Barling et al., 2002). Organizational changes suggested to transform culture are typically enacted through organizational climate, where the day-to-day tasks and behavior patterns culminate over time to contribute to the overall values and beliefs held by the organization as a whole.

Table 2.3 Contrasting Characteristics of Organizational Climate and Culture. This table shows key differences between organization climate and organizational culture. This table was adapted from Hoy (1990).

<table>
<thead>
<tr>
<th></th>
<th>Organizational Climate</th>
<th>Organizational Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discipline:</td>
<td>Psychology and Social Psychology</td>
<td>Anthropology and Sociology</td>
</tr>
<tr>
<td>Methodology:</td>
<td>Survey Research</td>
<td>Ethnographic Techniques</td>
</tr>
<tr>
<td></td>
<td>Multivariate Statistics</td>
<td>Linguistic Analysis</td>
</tr>
<tr>
<td>System Assumptions:</td>
<td>Rational System</td>
<td>Natural System</td>
</tr>
<tr>
<td>Level of Abstraction:</td>
<td>Concrete</td>
<td>Abstract</td>
</tr>
<tr>
<td>Content:</td>
<td>Perceptions of Behavior</td>
<td>Shared Assumptions and Values</td>
</tr>
</tbody>
</table>

2.4 Safety Culture to Inform Affordability Culture

Within organizations, subcultures may exist through the formation of groups with common social or professional interests (Palkhotnik & Rocco, 2011). Parallels can be drawn from the creation and implementation of safety culture as an organizational subculture to the concept of affordability culture as there is a lack of literature surrounding affordability culture in organizations. Safety culture is seen as a subcomponent of organizational corporate culture and alludes to individual, job, and
organizational features that impact and influence safety and health (Cooper, 2000). In a summary report on the Chernobyl nuclear accident, the International Atomic Energy Agency (1986) defined safety culture as the product of individual group values, attitudes, competencies, and patterns of behavior that determine the commitment to and the proficiency of an organization’s health and safety program (IAEA, 1986; Misnan & Mohammed, 2007). Safety culture is seen as a subcomponent of organizational culture and alludes to individual, job, and organizational features that impact and influence safety and health (Cooper, 2000; Misnan & Mohammed, 2007). Previous research regarding safety culture differentiates between the shared beliefs and values of an organization and the multiple goal-oriented interactions between people, jobs, and the organization (Cooper & Phillips, 2002). This differentiation emphasizes the importance of a safety climate as a complementary independent concept to safety culture (Cooper, 2000; Misnan & Mohammed, 2007) enacted through members’ day-to-day goal-directed behavior.

Development of a safety culture is dependent on deliberate manipulation of various organizational characteristics perceived to impact the safety of a project or program (Cooper, 2000). Taking this same approach, laying the foundation for affordability culture in an organization will likely require evaluation of organization areas which have an impact on the overall affordability of a project or program. By evaluating organizational behaviors in relation to affordability, further insight may be gained regarding what organizational characteristics are perceived to impact affordability and how these characteristics are currently perceived by organization members. These evaluations may potentially highlight areas of opportunity to prioritize affordable
practices and aid in encouraging organizational change when considering affordability as an organizational goal.

2.5 Organizational Behaviors of Affordability to Inform Affordability Culture

Typically, monetary indicators such as life cycle cost (Bankole et al., 2009; Defense Acquisition Guidebook, 2013) have been discussed in previous literature regarding affordability in industry, though research conducted by MIT for the Naval PostGraduate School (NPS) discussed the presence of non-monetary considerations of affordability (Schaffner et al., 2013). Non-monetary considerations of affordability were considered to be things outside of traditional forms such as lifecycle cost and focused on a system’s schedule of development and responsiveness to emerging needs. It is important to note that non-monetary considerations are not completely independent of monetary factors, but rather indirectly impact organizational finances. Non-monetary measures are difficult and even potentially impossible to represent in dollar amounts due to their temporal nature (Schaffner et al., 2013).

Non-monetary considerations such as schedule of development and organizational responsiveness can be considered organizational behaviors, as they are indicative of temporal performance and responsive action performed by an organization and its members. This construct of organizational responsiveness is associated with organizational agility, in which anticipated responses to an external stimulus are illustrative of an organization’s overall flexibility (Harraf et al., 2015). Previous research has linked an organization’s cultural values and organizational agility, stating that cultural aspects can influence organizational agility, either by supporting agility through generating innovation ability or hampering agility by creating conflicts between
competing value systems (Goncalves et al., 2019). The presence of non-monetary factors is often seen in literature examining organizational behaviors regarding incentives or rewards within organizations (Jordan et al., 2012; Ngcobo & Naidoo, 2015; Shakeel & But, 2015). Examples of non-monetary incentives relevant in public sector organizations include personal recognition, opportunities to advance to management or leadership positions, assignment of duties perceived as meaningful, and opportunities for training or personal development (Jordan et al., 2012). Non-monetary rewards identified as factors associated with staff retention include a pleasant work environment, job-interest, training and development, and time off (Ngcobo & Naidoo, 2015).

Beyond incentives and rewards, non-monetary factors have been associated with organizational behaviors like employee discretionary effort (Redmond & Sharafizad, 2020) as well as system implementation efforts (Annarelli et al., 2018). Non-monetary factors impacting discretionary effort include individual factors such as employee co-worker relationships, organizational factors such as recognition and organizational culture, job design and job characteristics such as job demand, and leadership and management factors such as quality interpersonal relations (Redmond & Sharafizad, 2020). Non-monetary aspects identified to be potentially impactful to the implementation of product service systems include design issues, managerial problems, technological factors, market outlooks, and legal/regulatory factors (Annarelli et al., 2018). While monetary considerations or indicators of affordability are important, these are not the only factors to consider when evaluating an affordability culture. Non-monetary aspects in the form of organizational behaviors are areas that can potentially be overlooked when examining affordability, as these are outside of the traditional financial lens in which
affordability is typically evaluated. This paper aims to understand the potential presence of non-monetary considerations associated with affordability culture by examining employee perspectives across a range of organizations.

Non-monetary considerations have been linked to organizational behaviors regarding rewarding and incentivizing employees (Jordan et al., 2012; Ngcobo & Naidoo, 2015; Shakeel & But, 2015), discretionary effort in organizations (Redmond & Sharafizad, 2020), and implementation effort of new systems (Annarelli et al., 2018). Though non-monetary considerations have been associated with affordability (Schaffner et al., 2013), there is a lack of research exploring potential links between non-monetary aspects of affordability and affordability definitions. As noted previously, affordability may be defined differently across various industries and organizations, and may even be defined differently within one singular organization. This paper aims to explore this potential link between organizational behaviors and definitions by evaluating definitions of affordability given by participants and examining if definitions feature non-monetary aspects of affordability. Some examples of non-monetary aspects of affordability given in definitions may include accessibility, temporal considerations such as schedule or time as a resource, organizational processes, and manpower as a resource, among various others. By understanding the potential presence of these non-monetary aspects of affordability, organizations can take these perceptions of what affordability means to organization members into consideration when evaluating organizational behaviors related to affordability. As an example, individuals defining affordability with temporal considerations may be more focused on schedule delays and milestone timelines when examining organizational behaviors that can be altered to improve affordability. Through
evaluating how organizational members define affordability, organizations can better understand the perceptions surrounding current affordability practices and behaviors.

**Research Question 1:** When defining affordability, are non-monetary aspects of affordability featured in participant responses?

Definitions of affordability vary from industry to industry and even within one singular organization. These definitions of affordability are often predominantly financially based, taking into consideration monetary aspects such as budgets and funding. The current study aims to examine the potential existence of non-monetary aspects of affordability featured within definitions of affordability.

**Hypothesis 1:** There will be a presence of non-monetary aspects of affordability included in affordability definition responses.

### 2.6 Organizational Components of Interest for Affordability

The following section will outline organizational components that can potentially influence an affordability culture. These organizational components include organizational goals, communication, working relationships, planning and scheduling, roles and responsibilities, processes, and budgetary aspects (see Figure 2.2). Each of these components is associated with affordability in some way, linking non-monetary organizational behaviors with associated monetary considerations such as cost of turnover, cost of duplicate work, cost of training, and cost of schedule delays. By evaluating affordability culture in terms of organizational components, specific areas of
interest can be highlighted to understand how each distinct group can be impactful to the overall affordability of a project or program.

![Diagram of Organizational Components](image)

**Figure 2.2** Organizational Components of an Affordability Culture. This figure depicts organizational components that may potentially impact affordability culture within an organization. This includes non-monetary considerations such as goals, communication, relationships, planning and scheduling, roles and responsibilities, and processes as well as monetary considerations such as budgets.

### 2.6.1 Organizational Goals

The overall goals of an organization impact the behavior of an organization and are affected by various factors such as policies, organizational culture, and organizational structure (Praveena devi & Geetha, 2022). When prioritizing a specific organizational
goal, it is important for organization members to clearly understand what those goals are to best align behavior with desired outcomes. Goal setting theory suggests specific goals result in higher levels of performance and organizational commitment (Moon, 2000; Rainey, 1997). A lack of goal clarity within an organization may negatively impact organizational wellbeing, and the clarification of organizational goals may be utilized as a tool to mitigate negative impacts introduced by this lack of understanding (Hansson & Anserzen, 2009). Probable determinants of clarity in organizational goals include communication (passing of information about the goal) and influence processes (consensus among individuals regarding the goal; Wieland, 1969). In addition to improving organizational wellbeing, goal clarity has been associated with reducing turnover intention through actions such as clarifying both individual and organizational goals as well as ensuring organization members view the aforementioned goals as important (Jung, 2014). Goal clarity has been identified as a key mediator of the interaction between organization member autonomy and performance feedback, suggesting that providing feedback and autonomy to organization members is associated with high levels of organizational goal clarity (Gonzalez-Mule et al., 2016). As aligning current practices with an affordability culture may be a goal for organizations, it is imperative that these organizations clarify goal specifics as well as goal importance in order to influence employee behavior to align with desired organizational outcomes.

2.6.2 Communication and Working Relationships

Organizational climate and culture are conveyed through communication within the organization, whether it be from leader to subordinate, as seen in leader-member-exchange theory (Graen & Uhl-Bien, 1995), or from colleague to colleague. The
communication behaviors within an organization can influence team member behavior and contribute to the overall organizational culture (Gajendran et al., 2012). Researchers have examined the relationship between management communication and employee performance, suggesting that management communication signals that the organization cares about the well-being and values the contributions of employees (Neves & Eisenberger, 2012). Leaders form unique relationships with each of their subordinates (Bauer et al., 2006) and these relationships are enhanced through leader-member exchange. Bauer and colleagues (2006) found that those with low quality leader-member exchange are the most vulnerable in terms of performance, turnover intentions, and actual turnover.

Communication has also been shown to impact organizations in terms of productivity loss. In a 2011 report titled “The Cost of Poor Communications”, 400 companies with approximately 100,000 employees each were surveyed and cited an average loss of $62.4 million per year for each company (Grossman, 2011). These losses were attributed to errors of omission by employees who misunderstood/were misinformed regarding company policies, business processes, job functions, or a combination of these three factors. This same report highlighted that leaders who were considered effective communicators were linked with 47% higher total returns to shareholders over the previous five years as compared to their ineffective counterparts. Communication behaviors and working relationships within an organization are important organizational factors that are not only associated with organizational culture and climate but could potentially impact the affordability of a project or program. As negative communication behaviors have shown to be costly to organizations,
understanding perceptions of current practices in this organizational domain can provide a deeper understanding of affordability culture in organizations.

2.6.3 Planning and Scheduling

Organizations have increasingly been focusing on strategic workforce planning in order to effectively ensure service delivery while simultaneously optimizing effectiveness (Melchor, 2013). Workforce planning and selection can be associated with financial efficiency at the organizational level (Perthame et al., 2017), impact employee retention and turnover rates (Banaszak-Holl et al., 2015), and influence organizational performance and success (Aldrich & Pullman, 2019). Workforce turnover has been shown to negatively impact general work climate (Brannon et al., 2002) as well as negatively impact the financial well-being of an organization (Hinkin & Tracey, 2000). When investigating workforce turnover, Wasmuth and Davis (1983) found that pay, poor quality of supervision, and poor working conditions were the most common reasons given for leaving an organization. Costs associated with turnover include separation costs, replacement costs, training costs, and an estimate of loss productivity (Hinkin & Tracey, 2000).

In addition to workforce planning, scheduling efforts may also influence the overall affordability of a program or project. Scheduling issues and delays are typically associated with cost overruns and can have adverse effects on working relationships and monetary resources (Ahmed et al., 2002; Chidambarram et al., 2012). Schedule delays have been attributed to various causes, including finance-related issues, project-related issues, workforce-related issues, and external issues among others (Chidambarram et al., 2012). Numerous factors associated with eventual cost overruns in a project have been
identified, including rework, fluctuation in money exchange rate, escalation of material price, additional work at owner’s request, and high transportation costs (Zaki et al., 2018). Organizations can estimate the cost of delay in project planning and scheduling by taking into account urgency and value of a project, and this estimation is known as a partial derivative of the total expected value with respect to time (Dolfing, 2019). Given the increase in project costs attributed to schedule delays and poor workforce planning, organizations examining internal practices should take into consideration current processes associated with planning and scheduling. As delays in scheduling and insufficient workforce planning can be costly to organizations, organizational behaviors relating to planning and scheduling can be impactful to the overall affordability of the organization. Organizations striving to implement an affordability culture would benefit from the evaluation of current scheduling and planning practices to determine if any improvements can be made to align organizational behaviors with desired affordability outcomes.

2.6.4 Roles and Responsibilities

Organization members understanding individual roles and responsibilities is imperative for organizational success. Previous research has shown a positive correlation between role clarity and job shadow training, where role clarity increased as time spent participating in on-the-job shadowing increased (Jenkins, 2015). Though training is beneficial for role clarity and professional development, it has been shown to be a costly investment for organizations. In a 2020 report, researchers found that companies ranging from 100 to 10,000 employees on average spent roughly $1,111 in training expenditures per learner in 2020 (Freifeld, 2020). Small companies (100 to 999 employees) spent an
average of $1,678 per learner in 2020 followed by midsize companies (1,000 to 9,999 employees), who spent an average of $581 in 2020 and rounded out by large companies (10,000 plus employees) who saw average spending amounts of $924 per learner in 2020. The overall average training budget for large companies in 2020 was $22 million, midsize companies averaged $808,355, and small companies dedicated an average of $506,819 in training and development per year. The cost of training is not the only factor to take into consideration when understanding the financial impact of training on an organization. The number of hours of training per employee in 2020 for all companies surveyed averaged 55.4 hours. These are hours dedicated to training rather than organizational productivity and training is oftentimes valued in terms of return on investment, where the losses of productivity during training hours are gained through skills and knowledge developed throughout the training process. Training and development are essential components to organizational growth, though costs associated with training such as instruction materials, equipment and time for training, and productivity loss should be considered when trying to conduct organizational training with affordability in mind.

Another costly issue related to roles and responsibilities often seen within organizations is the duplication of work. Duplication of work can manifest in numerous ways such as completing unnecessary tasks due to the task already being completed or the task being unnecessary in general (Fervers et al., 2006) or overlapping work with little to no communication between collaborators (Bandara, 2021). Financial resources are wasted in scenarios where multiple individuals are working on overlapping tasks that could realistically be done by one individual. In a study done by Papadakos and
colleagues (2020), researchers found that limiting the duplication of work between hospitals regarding the development of patient education materials in medical settings could substantially increase cost savings within the system of organizations. Following the global financial crisis of 2007, many countries within the Organization for Economic Co-operation and Development (OECD) opted for workforce restructuring in order to reorganize public finances and lower overall organizational expenditures (Melchor, 2013). The clarity of roles and responsibilities is an important aspect of an affordability culture as misunderstandings of employee expectations can lead to costly rework and training. By clarifying what is expected of organization members in terms of individual roles and responsibilities on the job, costly mistakes such as duplication of work and copious amounts of training and retraining can be minimized.

2.6.5 Engineering Processes

Another organizational aspect that can potentially impact project affordability is the engineering process utilized by an organization. There has been a growing emphasis within the aerospace industry to shift away from performance-based design and instead focus more on affordability-based design (Siedlak et al., 2015). Previous research by NPS emphasized designing for affordability should not only consider the monetary lifecycle cost of a system but should also take into consideration a system’s schedule of development and responsiveness to emerging needs (Schaffner et al., 2013). Both monetary and non-monetary considerations were prioritized by NPS when evaluating a potential measure capable of tracking design-based affordability, and Multi-Attribute Expense (MAE) function was suggested as a potential measure as it has been utilized before to capture both a system’s development time and the initial operating costs. In
another study conducted by NPS, affordability evaluation was broken down into three components: continuous cost engineering, soundness of program cornerstones, and resolution of harmful trends revealed by an affordability risk assessment (Anderson et al., 2012). Specifically, within the continuous cost engineering component discussed in the NPS research, it is stated that the program at hand should have a disciplined approach to risk and requirements management which includes but is not limited to integration of risk, cost, schedule, and requirements management as well as coordination with users and other active stakeholders (Anderson et al., 2012). In this component of affordability evaluation, corrective action to improve processes (i.e., requirements definition, system design, program planning) is recommended (Anderson et al., 2012).

Affordability has also been associated with technology-based changes. In a collaborative study conducted by Boeing and the Navy, technological advances by way of fiber optic gyro implementation were suggested in order to improve affordability in high precision submarine inertial navigation (Heckman & Baretela, 2000). Previous research has suggested technological changes through implementing integrated product/process development (IPPD) in order to improve rotorcraft affordability (Schrage, 1999). Technology related changes have been suggested in the medical field and telecommunication industry through the implementation of robotics and automation (Oppenheim 2013; Suri et al., 2013). The emphasis of new technologies to increase or improve affordability in organizations appears to be a growing trend within engineering processes.

Another process related factor that may potentially impact the affordability of an organization is waste. Within the lean manufacturing domain, waste is defined as the cost
affecting an organization and is considered one of the heaviest drains of profitability (Gay, 2022). The lean manufacturing model recognizes eight types of waste that may exist within an organization, all of which have negative impacts on the overall financial performance of the organization. These types of waste include defects, excess processing, overengineering, overproduction, waiting as a result of poor process design, inventory, transportation, motion in terms of utilization of space, and non-utilized talent (Gay, 2022). Being mindful of waste management and reducing wasteful efforts are pertinent when prioritizing a culture of affordability within an organization. As these excessive engineering processes can be costly and wasteful to organizational resources, an organization with an affordability culture would minimize these wasteful practices. Organizations wishing to create an affordability culture would benefit from evaluating current engineering processes to determine areas in which improvements can be made, such as reduction of production efforts, improved designs, or restructuring of engineering processes.

2.6.6 Budgetary Aspects

When one examines affordable practices in organizations, budgets and funding create the basis by which affordable practices are evaluated. Some funding approaches create unique situations in which affordability is de-incentivized, as seen in organizations associated with “use-it-or-lose-it” budgets. In these types of funding structures, organizations are encouraged to spend unused financial resources towards the end of the fiscal year as leftover resources do not extend to the next funding cycle (Khalil et al., 2019). As leftover resources are returned to the funding authority, incentives towards affordable practices are diminished and wasteful spending encouraged. Previous research
has shown that federal agencies spend an average of 4.9 times more during the last week of the fiscal year when compared to a typical week during any other time of the year (Liebman & Mahoney, 2017). Not only do these types of budgets discourage affordable practices, but they have also been associated with lower quality ratings of projects procured in the last week of the fiscal year (Liebman & Mahoney, 2017). These types of budgets are generally seen within federal agencies, such as the Department of Defense and NASA. This creates an interesting conundrum, as these agencies are often seen to be stewards of taxpayer dollars, indicating a moral responsibility to spend funding wisely, yet potentially discouraged from doing so dependent upon budget surpluses.

Understanding perceptions regarding budgetary aspects of affordability will allow organizations to evaluate employee beliefs surrounding current budgeting and funding practices. Evaluating current budgetary aspects of affordability is essential to an affordability culture as the types of funding and budgets utilized by organizations create resource constraints, both in terms of financial constraints and non-financial resource constraints, such as time and manpower. These constraints lay the foundation for organizational behaviors related to affordability, as all decision-making processes are impacted by the amount and type of funding allocated to organizations.

Though researching affordability within industry may prove to be beneficial for organizations, this research has a number of challenges when attempting to understand what an affordability culture entails. Affordability has been viewed in many situations as a metric, allowing evaluative measures to be conducted, rather than a culture to be enacted and practiced within an organization. As there is a lack of previous literature regarding affordability culture, one of the predominant challenges is assessing what
behaviors, norms, and values contribute to a culture of affordability. As there is also a lack of cohesive definition of affordability and different individuals may view affordability in differing terms, difficulties arise in adopting affordable practices. Organizations may claim that they operate with affordability at the forefront, but there is a lack of information regarding how exactly they prioritize affordability. An explanation of this may be organizations’ unwillingness to share information regarding money-saving practices, as these may be considered an advantage in industry and give these organizations a competitive edge. Various challenges exist within the scope of this research, but overcoming these barriers will allow for a better understanding of not only what an affordability culture is, but how to best enact this type of culture within an organization.

2.7 Research Objective

The overall goal of this study was to gain a better understanding of perceptions of affordability regarding affordability practices and currently existing affordability cultures. This study utilized both qualitative and quantitative approaches to research by analyzing employee responses regarding perceptions of affordability. A survey was sent to NASA’s Marshall Space Flight Center (MSFC) employees, industry members, and student respondents at The University of Alabama in Huntsville (UAH) to understand perceptions regarding affordability practices and currently existing affordability cultures across various organizations and demographic samples. Responses from NASA MSFC, industry members, and students were compared to examine any potential differences or similarities in perceptions of organizational behaviors relating to affordability. For an overview of all research questions and associated hypotheses, see Table 2.4.
**Research Question 2:** How do NASA employees perceive affordability?

As NASA is a government agency that often works with privately-owned companies in industry, NASA has a unique perspective regarding affordability. NASA is a government-funded agency, creating budgets and funding from tax-payer dollars. Perspectives on affordability from employees at NASA MSFC allow for an understanding of affordability from a government agency constrained by tax-funded budgets that may also be associated with expiring budgets and use-it-or-lose-it funding approaches. Responses from this group also allow for internal evaluations of affordability from a singular organizational unit, with perspectives ranging across various levels of the organizational hierarchy as well as across various career lengths. This research question allows for more insight regarding how perceptions of affordability may differ within one singular organization.

**Hypothesis 2:** There will be a significant difference in Likert ratings of organizational aspects (including non-monetary considerations of organizational goals, communication behaviors, working relationships, planning and scheduling behaviors, individual roles and responsibilities, and engineering processes in addition to monetary considerations such as budgets) given by NASA MSFC employees depending on the job category.

**Hypothesis 3:** There will be a significant difference in Likert ratings of organizational aspects (including non-monetary considerations of organizational goals, communication behaviors, working relationships, planning and scheduling behaviors, individual roles and responsibilities, and engineering processes in addition to monetary
considerations such as budgets) given by NASA MSFC employees depending upon years employed at NASA.

**Research Question 3:** How is affordability perceived across various demographic populations?

This research question aims to understand perceptions of organizational behaviors surrounding affordability across differing populations, including NASA MSFC employees, industry members, and student respondents. Given most students will be considered novices in career experience while industry members and NASA employees may be more experienced, various levels of experience will be taken into consideration. This research question will allow for the comparison of all three group types, including responses from a range of hierarchical levels, career lengths, budget/funding types, and organizational agency types. The comparison of these three groups will contribute to a growing body of research surrounding affordability perspectives by different organization types, including government and non-government. This will allow for a deeper understanding of current beliefs surrounding affordability culture in organizations.

**Hypothesis 4:** There will be a significant difference in the frequency of codes (including non-monetary codes such as organizational processes and engineering processes as well as monetary codes) when evaluating responses to open-ended questions regarding affordability improvements, wants, and barriers for NASA employees, industry members, and student respondents.

**Hypothesis 5:** There will be a significant difference in Likert ratings of organizational aspects (including non-monetary considerations of organizational goals,
communication behaviors, working relationships, planning and scheduling behaviors, individual roles and responsibilities, and engineering processes in addition to monetary considerations such as budgets) for NASA employees, industry members, and student respondents.
<table>
<thead>
<tr>
<th>Research Question</th>
<th>Hypotheses</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1: When defining affordability, are non-monetary aspects of affordability featured in participant responses?</td>
<td>H1: There will be a presence of non-monetary aspects of affordability included in affordability definition responses.</td>
</tr>
<tr>
<td>R2: How do NASA employees perceive affordability?</td>
<td>H2: There will be a significant difference in Likert ratings of organizational aspects (including non-monetary considerations of organizational goals, communication behaviors, working relationships, planning and scheduling behaviors, individual roles and responsibilities, and engineering processes in addition to monetary considerations such as budgets) given by NASA MSFC employees depending on the job category.</td>
</tr>
<tr>
<td>R3: How is affordability perceived across various demographic populations?</td>
<td>H3: There will be a significant difference in Likert ratings of organizational aspects (including non-monetary considerations of organizational goals, communication behaviors, working relationships, planning and scheduling behaviors, individual roles and responsibilities, and engineering processes in addition to monetary considerations such as budgets) given by NASA MSFC employees depending upon years employed at NASA.</td>
</tr>
<tr>
<td></td>
<td>H4: There will be a significant difference in the frequency of codes (including non-monetary codes such as organizational processes and engineering processes as well as monetary codes) when evaluating responses to open-ended questions regarding affordability improvements, wants, and barriers for NASA employees, industry members, and student respondents.</td>
</tr>
<tr>
<td></td>
<td>H5: There will be a significant difference in Likert ratings of organizational aspects (including non-monetary considerations of organizational goals, communication behaviors, working relationships, planning and scheduling behaviors, individual roles and responsibilities, and engineering processes in addition to monetary considerations such as budgets) for NASA employees, industry members, and student respondents.</td>
</tr>
</tbody>
</table>
Chapter 3. Method

3.1 Participants

Participant sample sizes for NASA participants, student participants, and industry participants were calculated using G* Power analysis. Participants were recruited from NASA MSFC as well as UAH and local industry to participate in the survey. Data were excluded from analysis if the participant requested their data be excluded or if the participant did not complete the survey in its entirety. In total, 378 NASA MSFC employees responded to the survey and after data exclusions, 171 participants remained. Two NASA participants opted to have their data excluded and 205 did not finish. In total, 386 UAH students and industry members not affiliated with NASA responded to the survey and, after data exclusions, 143 student participants and 32 industry participants remained. Three industry participants opted to have their data excluded, 39 did not finish, and eight participants were considered part of a pilot study in which the survey was taken for feedback on potential issues and corrections. Sixty-seven student participants opted to have their data excluded and 94 did not finish. Respondents that did not complete the survey were considered to have withdrawn from the study. In total, 418 responses were omitted from analysis leaving a total of 171 participants from NASA, 32 participants from industry, and 143 students whose data were analyzed. IRB approval was obtained, and appropriate ethical guidelines followed. Students participated in this study in exchange for credit in their introductory psychology courses. Two students participated
voluntarily from the college of engineering at UAH. NASA and industry member respondents participated on a voluntary basis, expecting no compensation for their time.

3.2 Materials

The affordability survey was administered online via Qualtrics software (Qualtrics, 2005). Qualtrics is a technology platform used to collect, manage, and analyze data via surveys and polls. It is particularly useful for the analysis of qualitative research. Students who participated in the study signed up through SONA (Sona Systems, n.d.), a research participation and management tool for university studies. Participants were required to have access to a computer, tablet, or mobile phone in order to complete the survey.

3.3 Development of Affordability Survey

The development of the affordability survey was conducted through expert workshops and was created using previously validated measures. Initial questions featured in the survey stemmed solely from the Organizational Climate Measure (Patterson et al., 2005) and the Project Organizational Culture Framework (Nguyen & Watanabe, 2017); however, some of the questions did not apply to the context of the current study. Through two expert workshops, questions were refined and adapted from a total of 120 questions to the 37 questions featured now. In addition, the expert workshop resulted in the development of an additional 15 questions (included in the total 37) as well as ranking questions to gain a better understanding of current affordability perceptions and practices. A pilot study with $N = 8$ was conducted in order to improve readability and understanding of the questions. The affordability survey developed and
distributed consisted of four open-ended questions, 37 closed-ended Likert scale questions, three ranking questions, and 10 demographic questions. All questions included themes of affordability, organizational culture, and organizational climate. Questions were answered on a 7-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (7). For the full survey, see Appendix A.

3.3.1 Open-Ended Questions

The four open-ended questions featured within the affordability survey allowed participants to freely respond to a number of affordability-related prompts. Qualitative responses from this portion of the survey were examined to generate coding schemes to better understand themes of content within the responses. For the full list of open-ended questions, see Table 3.1.

Table 3.1 Open-Ended Affordability Survey Questions. This table lists open-ended questions that were generated by the research group and featured at the beginning of the affordability survey.

<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What does “affordability” mean to you?</td>
</tr>
<tr>
<td>2. What would you do if you were asked to improve the affordability of the program you are currently working on?</td>
</tr>
<tr>
<td>3. What cultural barriers potentially hindering affordability have you encountered in your program?</td>
</tr>
<tr>
<td>4. Why would you want an affordability culture in your program?</td>
</tr>
</tbody>
</table>
3.3.2 Organizational Climate Measure (OCM)

Seventeen closed-ended questions were adapted from the Organizational Climate Measure (OCM; Patterson et al., 2005) such as “There are often breakdowns in communication here.” This measure was used to assess employee perceptions of organizational climate. A competing values framework featuring aspects of stability versus control and internal versus external focus (Quinn & Rorbaugh, 1983) was utilized as a foundation for the OCM as a multidimensional measure of climate. In the development of the OCM, climate perceptions were measured on 17 different items: autonomy, integration, involvement, supervisory support, training, welfare, formalization, tradition, innovation and flexibility, outward focus, reflexivity, clarity of organization goal, efficiency, effort, performance, feedback, pressure to produce, and quality. All scales within the OCM, with the exception of Autonomy, resulted in internal consistency estimates with alpha levels at or above 0.73. A Cronbach’s alpha level greater than 0.70 is considered acceptable regarding reliability testing (Pallant, 2007; Sharma & Mukherjee, 1996). Organizational climate indices result in a median internal consistency reliability of 0.87 (Ostroff, 1993). For the full OCM, see Appendix C.

3.3.3 Project Organizational Culture Framework (POCF)

Thirteen questions within the affordability survey distributed to NASA MSFC and industry employees were also adapted from the Project Organizational Culture Framework (POCF; Nguyen & Watanabe, 2017), such as “Information is shared, transparent, and available to all participants over the course of the project.” While the OCM focuses more on climate within the organization, the POCF captures team member
perceptions regarding organizational culture. When creating the POCF, the purpose was to develop a framework for an organizational culture model in construction-related organizations at the project level. The POCF did not feature item dimensions in the same way as the OCM. In the POCF, cultural artifacts were generated and grouped into significant cultural factors (Nguyen & Watanabe, 2017). These cultural factors included goal alignment and reliance, contractor commitment, cooperative orientation, empowerment orientation, and worker orientation. When evaluating internal consistency during the development of the POCF, Cronbach’s alpha values ranged from 0.66 to 0.90, indicating an acceptable reliability level. Principal component analysis was used to demonstrate both convergent and discriminant validity for the POCF (Nguyen & Watanabe, 2017). For the full POCF, see Appendix D.

3.3.4 Original Questions Generated for Survey

Fifteen original questions were created by the research group such as “Your program rarely stays within its fiscal year budget” that were included to address any affordability aspects of interest not captured in the questions adapted from the OCM and POCF. For a list of survey questions with their associated original sources, see Table B.1 in Appendix B.

3.3.5 Demographics

Ten demographic questions were included to gain a deeper understanding of respondent characteristics as well as characteristics of the organization associated with each respondent. Demographic questions prompted participants regarding various topics
such as educational background, career background, organization size, and industry type. For the full list of demographic questions, see Appendix E.

3.4 Procedure

Participants from NASA MSFC and industry members not affiliated with NASA were contacted via email and sent a link to complete the survey via Qualtrics survey hosting platform. Students from UAH were given access to the Qualtrics survey link via the university’s online research experiment platform SONA. The online survey began with a consent portion wherein the participant gave permission for data to be collected and analyzed. The survey was completed in roughly one hour and participants were debriefed then allowed to exit the study. Data were exported from Qualtrics and downloaded into an excel spreadsheet for cleaning and further analysis. No identifying information was collected during the survey and participant numbers were assigned to data once collected.

3.5 Statistics

The analysis of survey data began with the qualitative thematic analyses of the open-ended questions regarding affordability definition, improvement, cultural wants, and cultural barriers. Thematic analysis has been described as a method for identifying, analyzing, and reporting patterns or themes within data qualitatively and can be used on both inductive and deductive coding approaches (Braun & Clarke, 2006; Vaismoradi et al., 2013). Thematic analysis allows for researchers to understand and make sense of collective shared meanings and experiences (Braun & Clarke, 2006). Thematic analysis is rather flexible and can be conducted in a number of ways (Braun & Clarke, 2006), with
the current paper focusing on an inductive approach. Once qualitative analyses were complete, data were quantitatively evaluated using Likert ratings of organizational behaviors to understand perceptions surrounding affordability.

3.5.1 Qualitative Analysis: Affordability Definitions

Qualitative analysis began with evaluating responses to the prompt regarding affordability definitions to understand if there is a presence of non-monetary aspects in definitions of affordability given by survey respondents, as discussed in Research Question 1. Affordability definitions given by participants were examined and notes were taken if definitions included non-monetary aspects. Examples of non-monetary aspects include quality, flexibility, benefits, and schedule. Any part of the definition that was not discussing affordability in the context of dollars and cents was considered to include a non-monetary aspect. Definitions focusing on just budget or funding were considered purely monetary. Each definition was only counted one time when categorizing responses. An example of this purely financial definition would be, “Affordability is staying under budget.” An example of a definition including non-financial aspects would be, “Affordability is staying under budget and under schedule.” Once the responses were examined and notes taken, a frequency count was completed to understand the percentage of definitions that included non-monetary aspects. For a graphical representation of the thematic analysis process utilized for affordability definitions, see Section A of Figure 3.1.
3.5.2 Qualitative Analysis: Generation of Coding Schemes

Following the analysis of affordability definitions, qualitative thematic analysis was utilized to evaluate the remaining three open-ended questions regarding improvement, cultural wants, and cultural barriers. Each question was analyzed individually, though the process remained the same for all three and resulted in a coding scheme to categorize responses. Participant survey responses were reviewed and then notes generated to indicate any sort of patterns or repeating themes. These notes were then grouped according to likeness and preliminary codes created out of these groupings. The preliminary coding scheme was generated and applied to the data. For a graphical representation of the thematic analysis process utilized for the generation of coding schemes, see Section B of Figure 3.1. Frequency counts of responses per category were generated and any category that had less than 10 responses were collapsed into appropriate categories with larger response counts. As qualitative thematic analysis was utilized, no peer review process for coding was required for this study. The final coding schemes for each open-ended question used in this study as well as examples of responses in each category can be seen in Tables 3.2 through 3.4. Each of these coding schemes is broken down into three main categories: organizational factors, engineering process factors, and monetary factors. These factors coincide with the organizational components of affordability culture seen in Figure 2.2. Organizational processes include organizational goals, communication, roles and responsibilities, working relationships, and planning and scheduling. Engineering processes include any sort of manufacturing and production in an organization, including design and development. Budgetary aspects include any sort of monetary considerations pertaining to affordability such as budgets.
and funding. These categories allow for examination into specific organizational areas in which focus can be shifted according to employee perspectives.

**Figure 3.1** Thematic Analysis Process for Qualitative Statistics. This figure shows both thematic analysis processes for the evaluation of qualitative data.
Table 3.2 Affordability Improvement Codes. This table lists the codes generated to categorize affordability improvement responses as well as definitions and examples of each code. Non-responses such as “I'm not sure” were noted but not included in the comparison of responses.

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve Organizational Aspects</td>
<td>Responses in which organizational aspects are the primary focus; examples include improving organizational operations/processes, structure, improving perceptions of risk, modernization of organization, improving business practices, improved handling of contracts, reduction of organizational waste, improving working relationships, reduction of personnel/paperwork, etc.</td>
</tr>
<tr>
<td>Improve Engineering Processes</td>
<td>Responses in which design and development processes at the engineering level are the primary focus; examples include improving materials, improving requirements, streamlining processes, etc.</td>
</tr>
<tr>
<td>Improve Monetary Aspects</td>
<td>Responses in which financial aspects are the primary focus; examples include cost reduction, reducing spending, improving budgets, improving funding, etc.</td>
</tr>
</tbody>
</table>

Table 3.3 Cultural Wants Codes. This table lists the codes generated to categorize responses to why respondents would want an affordability culture in their organization as well as definitions and examples of each code. Non-responses such as “I am not sure” were noted but not included in the comparison of responses.

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Process Factors</td>
<td>Responses in which a benefit to the organization is the primary focus; examples include priorities, strategies, justification to customer, organizational effectiveness, organizational efficiency</td>
</tr>
<tr>
<td>Engineering Process Factors</td>
<td>Responses in which a benefit to the engineering processes such as design and development is the primary focus; examples include effective processes, efficient processes, waste reduction</td>
</tr>
<tr>
<td>Monetary Factors</td>
<td>Responses in which financial benefits are the primary focus; examples include cost reduction, staying under budget, can do more with current funding</td>
</tr>
</tbody>
</table>
Table 3.4 Cultural Barriers Codes. This table lists the codes generated to categorize responses to what barriers may exist within their organization hindering an affordability culture as well as definitions and examples of each code. Non-responses such as “I am not sure” were noted but not included in the comparison of responses.

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Process Barriers</td>
<td>Responses in which organizational aspects are the primary barrier; examples include organizational resistance, workforce/workflow, organizational culture, tradition</td>
</tr>
<tr>
<td>Engineering Process Barriers</td>
<td>Responses in which design and development processes at the engineering level are the primary barrier; examples include testing, schedule, requirements</td>
</tr>
<tr>
<td>Monetary Barriers</td>
<td>Responses in which financial aspects are the primary barrier; examples include budgetary constraints, funding</td>
</tr>
</tbody>
</table>

3.5.3 Qualitative Analysis: Singular Organization Comparison of Code Frequencies

The Chi-square goodness-of-fit test was utilized to examine potential differences in code frequency given by NASA MSFC employees, industry members, and student respondents for the three open-ended questions regarding affordability improvement, cultural wants, and cultural barriers. The Chi-square goodness-of-fit test was chosen as this is a nonparametric statistical analysis conducted on a single sample (Laerd Statistics, n.d.) to understand potential significant differences in code frequencies given by respondents.

3.5.4 Qualitative Analysis: Between-Group Comparison of Code Frequencies

The Chi-square test of independence was utilized to examine potential associations between demographic grouping (NASA, industry, student) and code frequency for the three open-ended questions regarding affordability improvement, cultural wants, and cultural barriers. The Chi-square test of independence was chosen as
this is a non-parametric statistical analysis that is distribution free, therefore different sample sizes can be compared (McHugh, 2013). The dependent variable (affordability code) is on a nominal scale for all three open-ended questions, further supporting the choice of Chi-square test of independence as an appropriate measure (McHugh, 2013). The Chi-square test of independence can be used in situations where the independent variable has two or more levels, making it appropriate for NASA, industry, and student comparison. The Cramer’s V test was utilized as a follow-up test to the Chi-square test of independence as a measure of the strength of association between variables for significant Chi-square tests (McHugh, 2013).

3.5.5 Quantitative Analysis: Affordability Groupings

In order to evaluate participants' perceptions regarding certain themes that align with affordability practices, researchers created affordability groupings to better analyze participants' responses. These affordability groupings were generated using the affordability model presented in Figure 2.2 as a foundation from which the groupings were derived. Thematic analysis was again utilized in order to group questions by content theme (Braun & Clarke, 2006). In a first step, the closed-ended questions were grouped into affordability groupings based on similar question content, here referred to as themes, to enable comparison of perceptions surrounding organizational components across various demographic groupings, such as NASA, student respondents, and industry members. Affordability groupings were determined by evaluating each individual question’s theme, then grouping the question with others that contained similar themes of affordability. In a second step, definitions were generated for each group in order to provide context regarding the question themes within each category. For a graphical
representation of the thematic analysis process utilized to create affordability groupings, see Section C of Figure 3.2. Groupings and definitions can be seen in Table 3.5. These groupings are subjective categorizations of organizational operations (i.e., affordability practices, culture and climate) based on individual employee perceptions. These groupings do not reflect the behavior in the organization, but rather employee perceptions of the behavior and are highly impacted by individual differences.

**Figure 3.2** Thematic Analysis Process for Quantitative Statistics. This figure shows the process to generate the affordability groups that allow for categorization and comparison of responses.
Table 3.5 Affordability Groupings and Definitions. This table lists each affordability grouping of questions within the Likert portion of the affordability as well as definitions and examples of question theme within each group.

<table>
<thead>
<tr>
<th>Affordability Grouping</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarity of Organizational Goals</td>
<td>Overall goals and priorities of the organization; examples include individual impact, purpose and direction, and program culture.</td>
</tr>
<tr>
<td>Efficiency in Communication</td>
<td>Communication behaviors within the organization; examples include actively seeking stakeholder comments, breakdown of communication, clarity of communication, and availability of information.</td>
</tr>
<tr>
<td>Effective Working Relationships</td>
<td>Professional personal connections within the organization; examples include willingness to exchange ideas, accountability issues, cooperation and collaboration.</td>
</tr>
<tr>
<td>Efficiency in Planning and Scheduling</td>
<td>Planning and scheduling efficiency within the organization; examples include delivery time, timeline organization, and satisfaction with schedule.</td>
</tr>
<tr>
<td>Clarity of Roles and Responsibilities</td>
<td>Clarity of individual team member roles and responsibilities within the organization; examples include understanding expectations, performance feedback, and stakeholder empowerment.</td>
</tr>
<tr>
<td>Efficiency in Processes</td>
<td>Process efficiency within the organization; examples include interest in efficient processes/methods, and process adaptability.</td>
</tr>
<tr>
<td>Budgetary Aspects of Affordability</td>
<td>Financial aspects of the organization; examples include cost, budget, and satisfaction with affordability.</td>
</tr>
</tbody>
</table>

3.5.6 Quantitative Analysis: Internal Consistency of Affordability Groupings

In order to examine employee perceptions of various organizational aspects, questions within the affordability survey were grouped according to similar question content and internal consistency was evaluated. Internal consistency is often used as an index of reliability describing the extent to which items within a survey measure the same
construct (Tavakol & Dennick, 2011). Internal consistency was evaluated for each of the affordability groups in the survey individually as each affordability group represented a separate concept. In cases where multiple constructs or concepts are being measured in one survey, calculating internal consistency as a whole for the survey will inflate the value of alpha (Tavakol & Dennick, 2011). Cronbach’s alpha was calculated to determine consistency of questions within each affordability group. This ensures that questions in each affordability grouping are measuring the same construct, supporting the appropriateness of grouping specific questions based on content. This initial step laid the foundation for all subsequent statistical analyses surrounding Likert ratings of organizational behaviors featured in the current study. These groupings allow for the evaluation of current perceptions regarding affordability across numerous facets of an organization, such as communication behaviors or engineering processes.

3.5.7 Quantitative Analysis: NASA Within-Group Agreement

In order to establish comparison groups, within-group agreement was assessed to determine appropriateness of aggregation. Interrater agreement can be used to quantify consensus in ratings of a target and has been used previously to aggregate organizational culture ratings to the organizational level (O’Neill, 2017). Within-group agreement determines appropriateness when attempting to aggregate responses to the group level (Biemann et al., 2012; Bommer et al., 2004). Group aggregation allowed for the establishment of organizational groups according to job category and years employed at NASA. Within-group agreement of job categories allowed for aggregation based on organizational position to understanding perceptions of affordability at differing levels of the organizational hierarchy. Within-group agreement of years employed at NASA
allowed for aggregation based on career length to understand perceptions of affordability across a range of employee experience levels. The establishment of within-group agreement for job category and years at NASA was a precursory step with the goal of establishing groups that can be later compared to examine between-group differences. Within-group agreement was assessed using an interrater agreement index to measure agreement on a single item (James et al., 1984). This index, referred to as $r_{WG}$, was first described as an index of interrater reliability (James et al., 1984) but was then recast as an index of interrater agreement as the statistic does not conform to classic measurement theory and more adequately assesses interrater agreement as opposed to interrater reliability (James et al., 1993). Estimates of $r_{WG}$ were calculated for each item in the survey and then aggregated to an average $r_{WG}$ value per demographic categories of interest. Two categories of within-group agreement were assessed: Likert ratings of organizational behaviors compared across job categories (engineering staff, technical staff, management, advisory, other) and Likert ratings of organizational behaviors compared across years at NASA categories (0-9, 10-19, 20-29, 30-39, 40-49).

### 3.5.8 Quantitative Analysis: NASA Between-Group Comparison

A between-group comparison regarding perceptions of affordability aspects was conducted using a Kruskal-Wallis independent samples test. The Kruskal-Wallis $H$ test can be used to determine if any statistically significant differences exist between three or more independently sampled groups (McKight & Najab, 2010). It is worth noting that this test can determine if there is a significant difference between groups but cannot determine which exact groups are significantly different from each other. This nonparametric approach was considered appropriate to compare independent samples as
the sample sizes for each group were not comparatively equal. Two categories of between-group agreement were assessed: Likert ratings of organizational behaviors compared across job categories (engineering staff, technical staff, management, advisory, other) and Likert ratings of organizational behaviors compared across years at NASA categories (0-9, 10-19, 20-29, 30-39, 40-49). Affordability grouping composite scores were generated for between-group comparison purposes. These composite scores were created by averaging individual participant ratings for each question per affordability grouping. These between-group comparisons allow for further insight into employee perceptions of affordability at NASA by determining any significant differences that may exist between organization members in differing job levels and across different experience levels.

3.5.9 Quantitative Analysis: NASA, Industry, and Student Between-Group Comparison

A between-group comparison of perceptions regarding affordability aspects was conducted using a Kruskal-Wallis H test to examine potential group differences that may exist between NASA employees, industry members, and student respondents on Likert ratings of questions within the different affordability groupings. A Kruskal-Wallis H test is the nonparametric alternative to the one-way ANOVA and an extension of the Mann-Whitney U test to allow for the comparison of more than two independent groups (Laerd Statistics, n.d.). Given the nominal nature of the three demographic groups being compared, the unequal sample sizes of each group, and the ordinal nature of the Likert data, a Kruskal-Wallis H test was considered appropriate. This between-group
comparison allows for further insight into any potential differences in perception between NASA employees, industry members, and student respondents.

3.5.10 Frequency Counts of Likert Data

Frequency counts for the 37 Likert question responses regarding organizational behaviors were generated to understand overall perceptions of affordability amongst NASA employees, currently employed students, and industry members. These frequency counts allow for further insight into employee perceptions regarding various affordability-related components of the organization. These employee perceptions come from all levels of the organizational hierarchy as well as across various levels of experience, resulting in a more holistic view of affordability perceptions in different organization types.
Chapter 4. Results

4.1 Qualitative Analysis: Affordability Definitions

Out of 171 definitions of affordability given by NASA MSFC employees, 44 responses included non-monetary considerations when defining affordability. Though the majority of definitions viewed affordability in a financial sense, there were a considerable number of responses that went beyond economic considerations and included organizational behaviors such as safety approaches, time/schedule management, risk acceptance, engineering processes, and quality standards. When prompted to define affordability, 1.17% of responses indicated a lack of understanding regarding what the question was asking, suggesting that the majority of NASA respondents understood the question and were able to answer to the best of their abilities.

Out of 32 definitions of affordability given by industry members, seven responses included non-monetary considerations when defining affordability. Non-monetary considerations included examples such as lifecycle maintainability, time/schedule management, organizational processes, and organizational culture among others. When prompted to define affordability, 15.63% of responses indicated a lack of understanding regarding the question, stating that the respondent did not understand the question or did not know how to respond. This suggests that the majority of respondents understood the nature of the question and could answer it to the best of their ability.
Out of 143 definitions of affordability given by student respondents, 19 responses included non-monetary considerations when defining affordability. Examples of non-monetary considerations included program sustainability, time/schedule management, product utility, and customer benefit among others. When prompted to define affordability, 42.66% of student responses indicated a lack of understanding regarding the nature of the question. Numerous students appeared to be describing affordability in terms of individual socioeconomic status rather than about affordability within a project, program, or organization. For the percentage of responses including non-monetary considerations, see Figure 4.1.
Figure 4.1 Affordability Definitions Given by NASA, Industry, and Students. This figure shows the percentage of definitions given by each demographic group that included non-monetary aspects. Examples of non-monetary aspects include time, schedule, safety, and quality.

When defining affordability, all three groups of respondents had some participants include non-monetary aspects within their definitions of affordability. Though these non-monetary factors were not featured in the majority of responses, their presence indicates that organizational behaviors outside of financial considerations can be
associated with affordability in an organization. Out of the three groups, NASA responses resulted in the highest percentage of definitions featuring non-monetary factors. Results from this analysis suggest that affordability definitions may encompass organizational behaviors beyond finances such as time and schedule management, risk acceptance and utility of products. These results indicate a presence of non-monetary aspects of affordability included in definitions, supporting Hypothesis 1. When evaluating response content, students more often seemed to misunderstand what the question was asking, focusing on individual financial standing and socioeconomic status as opposed to defining affordability as it relates to organizational projects or programs.

4.2 Qualitative Analysis: Affordability Improvement, Wants, and Barriers by Demographic Group

The coding schemes seen in Tables 3.2 through 3.4 were applied to responses given by NASA participants, industry members, and student respondents for each of the corresponding open-ended questions. Chi-square goodness-of-fit tests were conducted on each individual open-ended question for each demographic group (NASA, industry, students) to understand any significant differences in response frequencies that may exist.

When prompted regarding affordability improvement (What would you do if you were asked to improve the affordability of the program you are currently working on?), most NASA respondents suggested improvements that would fall within the organizational process category, $X^2 (2, N = 153) = 30.75, p = .000$. Examples of such improvements included the elimination of unnecessary work/personnel, reduction of any duplication of efforts, flattening of the organization, and streamlining business practices.
When evaluating responses, 1.17% of NASA responses indicated a lack of understanding regarding the question, suggesting the majority of respondents were somewhat familiar with affordability and understood what was being asked. Most industry members suggested improvements that would fall within the monetary aspects category, $X^2 (2, N = 32) = 6.44, p = .040$. Examples of such improvements included increasing the budget or reducing program costs. When evaluating responses, 3.13% of industry responses indicated a lack of understanding regarding the question, suggesting the majority of respondents were somewhat familiar with affordability and understood what was being asked. Most students suggested improvements that would fall within the monetary aspects category, $X^2 (2, N = 114) = 84.84, p = .000$. Examples of such improvements included cutting spending and increasing funding. When evaluating responses, 48.25% of student responses indicated a lack of understanding regarding the question, suggesting almost half of the respondents were not familiar with affordability or did not understand what was being asked. Numerous student responses suggest improvements to the affordability of college costs or classes, focusing on affordability within the university system as opposed to affordability in organizational projects or programs. Results for affordability improvement response types can be seen in Figure 4.2.
Figure 4.2 Affordability Improvement Responses. This figure shows the code frequency for each demographic group when prompted regarding affordability improvements.

When prompted regarding why one would want a culture of affordability (Why would you want an affordability culture in your program?), most NASA respondents suggested reasons for wanting an affordability culture that would fall within the organizational process category, $X^2 (2, N = 163) = 83.57, p = .000$. Examples of such benefits included program survivability, sustainability, minimization of schedule overruns, and image management. When evaluating responses, 2.33% of NASA responses indicated a lack of understanding regarding the question, suggesting the majority of respondents were somewhat familiar with affordability and understood what was being asked. Most industry members suggested reasons for wanting an affordability culture that would fall within the organizational processes category, $X^2 (2, N = 30) = 11.40, p = .003$. Examples of such benefits included increased efficiency, increased
competitiveness, and increased program success, among others. When evaluating responses, 12.50% of industry responses indicated a lack of understanding regarding the question, suggesting the majority of respondents were somewhat familiar with affordability and understood what was being asked. Most students suggested reasons for wanting an affordability culture that would fall within the monetary aspects category, $X^2 (2, N = 114) = 91.95, p = .000$. Such benefits included increased accessibility and increased financial stability. When evaluating responses, 51.72% of student responses indicated a lack of understanding regarding the question, suggesting over half of student respondents did not understand what was being asked or were not familiar with affordability. Results for affordability culture wants can be seen in Figure 4.3.

**Figure 4.3** Cultural Wants Responses. This figure shows the code frequency for each demographic group when prompted regarding why the respondent would want an affordability culture in their organization.
When prompted as to what cultural barriers may exist hindering affordability within their organization (What cultural barriers potentially hindering affordability have you encountered in your program?), most NASA respondents suggested barriers that would fall within the organizational processes category, \( X^2 (2, N = 143) = 143.05, p = .000 \). Examples of such barriers included aversion to new technologies, bureaucracy within the organization, resistance to change, and NASA’s culture of tradition, among others. When evaluating responses, 4.68% of NASA responses indicated a lack of understanding regarding the question, suggesting the majority of respondents were somewhat familiar with affordability and understood what was being asked. Most industry members suggested barriers that would fall within the organizational process category, \( X^2 (2, N = 20) = 13.30, p = .001 \). Examples of such barriers included unnecessary processes and procedures, aversion to change, and resistance to innovation, among others. When evaluating responses, 9.38% of industry responses indicated a lack of understanding regarding the question, suggesting the majority of respondents were somewhat familiar with affordability and understood what was being asked. Most students suggested barriers that would fall within the monetary category, \( X^2 (2, N = 53) = 24.04, p = .000 \). Examples of such monetary barriers include a lack of financial accessibility and high cost of supplies. When evaluating responses, 55.24% of student responses indicated a lack of understanding regarding the question, suggesting over half of student respondents did not understand what was being asked or were not familiar with affordability. Most students appeared to be evaluating culture in terms of societal culture rather than specifically evaluating organizational culture. Results for barriers to affordability culture can be seen in Figure 4.4.
Figure 4.4 Cultural Barriers Responses. This figure shows the code frequency for each demographic group when prompted what potential barriers exist in their organization potentially hindering an affordability culture.

When prompted regarding affordability improvement, wanting an affordability culture, and barriers to an affordability culture, the majority of NASA participants gave responses that focused on organizational interventions (such as reduce workforce), benefits (such as reputation and image management), and hinderances (such as aversion to change) when evaluating current organizational behaviors as they relate to affordability. Industry responses resulted in similar patterns to NASA when focusing on organizational benefits and hindrances but were more aligned with student perceptions when suggesting monetary interventions to improve affordability. Students focused on monetary responses for all three open-ended questions, suggesting that students are more often perceiving affordability in terms of financially based aspects, such as budgets and funding. The presence of non-monetary considerations in industry and NASA responses
may indicate that with career experience, organization members are evaluating more organizational processes impacting affordability as opposed to simply looking at how much money is being allocated to their project or program. Where this seems to differ is when suggesting improvement approaches, industry tended to suggest more financial considerations seemingly shifting the responsibility of affordability to getting more funding or increasing budgets rather than altering any organizational behaviors.

4.3 Qualitative Analysis: Between-Group Comparison of Affordability Improvements, Wants, and Barriers

In order to examine any potential group differences in perceptions regarding affordability, a between-group comparison was conducted using student, industry, and NASA responses to each open-ended question. Distribution of responses can be seen in Figures 4.5 through 4.7.

Figure 4.5 Affordability Improvement Response Distribution for NASA, Industry, and Students. This figure depicts the group differences in code frequency when prompted regarding affordability improvement.
When prompted regarding affordability improvement, a significant association could be seen between demographic group (industry, student, NASA) and code frequency, $X^2(4, N = 299) = 76.55, p = .000, V = .36$. The effect size indicates moderate strength of the association between demographic group and affordability improvement code frequency (IBM, n.d.). Students more frequently suggested financial improvements than industry members, while NASA respondents suggested more organizational improvements and engineering process improvements than both students and industry members (see Figure 4.5). Examples of organizational improvements include improving organizational efficiency, removing levels of bureaucracy, rearranging the workforce, and streamlining management.

![Figure 4.6 Cultural Wants Response Distribution for NASA, Industry, and Students](image)

When prompted regarding cultural wants, a significant association could be seen between demographic group (industry, student, NASA) and code frequency, $X^2(4, N =$
Students more frequently suggested financial factors than industry members when prompted as to why they would want an affordability culture (see Figure 4.6). Again, NASA respondents more frequently suggested organizational factors as cultural wants as well as more frequently suggested engineering factors as compared to students and industry members. These cultural wants include marketability, organizational effectiveness, justification to taxpayers, and organizational efficiency.

![Figure 4.7 Cultural Barriers Response Distribution for NASA, Industry, and Students. This figure depicts the group differences in code frequency when prompted regarding potential barriers hindering affordability in organizations.](image)

When prompted regarding cultural barriers, a significant association could be seen between demographic group (industry, student, NASA) and code frequency, \( X^2 (4, N = 216) = 66.67, p = .000, V = .39 \). The effect size indicates moderate strength of the association between demographic group and cultural barriers code frequency (IBM, n.d.).
Students more frequently suggested financial barriers than industry members when prompted as to what barriers may be a hindrance to an affordability culture (see Figure 4.7). NASA respondents suggested both organizational barriers and engineering process barriers more frequently than industry and students, with few responses suggesting financial barriers to affordability. These organizational process barriers to an affordability culture include aversion to new technology, organizational resistance, and adhering to status quo or tradition.

All three open-ended questions resulted in significant group differences, with student responses more frequently aligning with financial factors and both NASA and industry more frequently aligning with organizational factors associated with affordability. NASA tended to suggest organizational and engineering factors more frequently than industry, though these two groups were similar in perceptions. These results support Hypothesis 4, indicating a significant association between whether an individual is a student respondent, industry member, or NASA MSFC employee and their subsequent responses to open-ended questions related to affordability improvements, cultural wants, and cultural barriers to affordability. Again, it appears that with longer time spent in an organization, respondents tend to view affordability in terms of organizational development approaches as opposed to simply evaluating in terms of funding or budgets.

4.4 Quantitative Analysis: Internal Consistency of Affordability Groupings

Cronbach’s alpha was calculated to determine consistency of questions within each affordability group (see Table 4.1). There are numerous qualitative descriptors used to interpret alpha values as there is no standardized approach or categorization (Taber,
Though no standardized interpretation exists, an alpha value of 0.70 is often seen as a rule of thumb minimum value to signify an acceptable alpha level (Tavakol & Dennick, 2011; van Griethuijsen et al., 2015; Taber, 2018). Other interpretations give more detailed categorization to alpha values, such as the following: > 0.90, excellent; > 0.80, good; > 0.70, acceptable; > 0.60, questionable; > 0.50 poor; and < 0.50, unacceptable (George & Mallery, 2003; Gliem & Gliem, 2003). All affordability groupings resulted in alpha levels above the satisfactory level of 0.70, with the exception of Effective Working Relationships (0.69) and Efficiency in Planning and Scheduling (0.48). Previous research has suggested that instruments with low alpha levels can still prove useful in some circumstances (Schmitt, 1996; Taber, 2018). Low alpha levels may be attributed to various reasons, such as a low number of questions or items, poor interrelatedness between items, or heterogeneous constructs (Tavakol & Dennick, 2011; van Griethuijsen et al., 2015).

Further exploration into these categories with alpha levels below the 0.70 threshold consisted of item-by-item assessment of Cronbach’s alpha to determine if any specific questions were contributing to these lower values. When evaluating both categories of Effective Working Relationships and Efficiency in Planning and Scheduling, it was determined that elimination of single-item questions within each affordability grouping did not result in an increase of alpha levels above the 0.70 threshold, therefore all questions were left in for the survey.
Table 4.1 Cronbach’s Alpha per Affordability Group. This table includes the internal consistency for each affordability grouping along with descriptive statistics.

<table>
<thead>
<tr>
<th>Affordability Grouping</th>
<th>Cronbach’s Alpha</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarity of Organizational Goals</td>
<td>0.75</td>
<td>4.45</td>
<td>1.53</td>
</tr>
<tr>
<td>Efficiency in Communication</td>
<td>0.81</td>
<td>4.45</td>
<td>1.58</td>
</tr>
<tr>
<td>Effective Working Relationships</td>
<td>0.69</td>
<td>4.68</td>
<td>1.57</td>
</tr>
<tr>
<td>Efficiency in Planning and Scheduling</td>
<td>0.48</td>
<td>3.56</td>
<td>1.54</td>
</tr>
<tr>
<td>Clarity of Roles and Responsibilities</td>
<td>0.77</td>
<td>4.59</td>
<td>1.51</td>
</tr>
<tr>
<td>Efficiency in Processes</td>
<td>0.74</td>
<td>4.50</td>
<td>1.61</td>
</tr>
<tr>
<td>Budgetary Aspects of Affordability</td>
<td>0.70</td>
<td>3.41</td>
<td>1.58</td>
</tr>
</tbody>
</table>

4.5 Quantitative Analysis: Frequency Counts of Likert Data

For full NASA response distributions per affordability grouping, see Figures G.1 through G.7 in Appendix G. For full student response distributions per affordability grouping, see Figures G.8 through G.14 in Appendix G. For full industry member response distributions per affordability grouping, see Figures G.15 through G.21 in Appendix G.

4.6 Quantitative Analysis: Within-Group Agreement to Establish NASA Groups for Comparison

Similar to Cronbach’s alpha, there is no standardized interpretation of $r_{WG}$ values in terms of levels of agreement, though a general rule-of-thumb is a value of 0.70 as a cut-off point to indicate within-group interrater agreement (James, 1982; Patterson et al.,
Previous research has indicated that an $r_{WG}$ value equal to or greater than .70 suggests that aggregation to the group level is valid (Bommer et al., 2004; Biemann et al., 2012). More specific interpretations of values have been suggested, such as the following: lack of agreement = .00 to .30; weak agreement = .31 to .50; moderate agreement = .51 to .70; strong agreement = .71 to .90; very strong agreement = .91 to 1 (LeBreton & Senter, 2008; Bieman et al., 2012).

### 4.6.1 Establishing Within-Group Agreement for Job Categories

Within-group interrater agreement was assessed for agreement across affordability groupings per job category. For job category interrater agreement analysis, job titles of “Other” and “Advisory” were excluded as there was only one observation per each category. Initially, 11 participants responded that they belong in the “Other” labor category, but upon review all but one could be considered management, technical staff, or engineering staff and were collapsed into the appropriate groups for data analysis. Results indicate that interrater agreement is of an acceptable level for all categories, with the exception of technical staff being slightly below the suggested 0.70 cutoff value. Even with the lower $r_{WG}$ value seen with technical staff, all job categories were considered to have at least moderate agreement, with most being considered to have strong agreement. For $r_{WG}$ values per job category, see Table 4.2.
Table 4.2 Interrater Agreement Estimates per NASA Job Category. This table shows the level of agreement for each job category on Likert ratings of organizational behavior.

<table>
<thead>
<tr>
<th>NASA Job Category</th>
<th>rWG mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Staff</td>
<td>0.72</td>
</tr>
<tr>
<td>Technical Staff</td>
<td>0.67</td>
</tr>
<tr>
<td>Management</td>
<td>0.72</td>
</tr>
</tbody>
</table>

4.6.2 Affordability Groupings by Job Title Comparison

A Kruskal-Wallis test was performed on the composite scores of the three groups (engineering staff, technical staff, and management). For questions within the Clarity of Organizational Goals affordability group, the differences between the rank totals of 83.19 (engineering staff), 94.22 (technical staff), and 85.88 (management) were non-significant, $H (2, n = 169) = .81, p = .668$. For questions within the Efficiency in Communication affordability group, the differences between the rank totals of 83.05 (engineering staff), 92.56 (technical staff), and 87.03 (management) were non-significant, $H (2, n = 169) = .67, p = .713$. For questions within the Effective Working Relationships affordability group, the differences between the rank totals of 84.78 (engineering staff), 81.47 (technical staff), and 87.20 (management) were non-significant, $H (2, n = 169) = .18, p = .915$. For questions within the Efficiency of Planning and Scheduling affordability group, the differences between the rank totals of 82.45 (engineering staff), 101.61 (technical staff), and 84.60 (management) were non-significant, $H (2, n = 169) = 2.39, p = .303$. For questions within the Clarity of Roles and Responsibilities affordability group, the differences between the rank totals of 81.54 (engineering staff), 82.28 (technical staff),
and 95.83 (management) were non-significant, $H (2, n = 169) = 2.57, p = .276$. For questions within the Efficiency of Processes affordability group, the differences between the rank totals of 84.94 (engineering staff), 88.64 (technical staff), and 83.53 (management) were non-significant, $H (2, n = 169) = 0.14, p = .934$. For questions within the Budgetary Aspects affordability group, the differences between the rank totals of 86.50 (engineering staff), 88.06 (technical staff), and 79.45 (management) were non-significant, $H (2, n = 169) = 0.69, p = .708$. Results from this test indicated no significant difference in the distribution of Likert ratings between each of the three job titles analyzed for all affordability groupings, thus Hypothesis 2 was not supported (see Table 4.3).

Table 4.3 Independent Samples Comparison of Affordability Aspects by Job Category. This table shows significance levels for group comparisons of affordability grouping ratings when examining job category.

<table>
<thead>
<tr>
<th>Affordability Grouping</th>
<th>Kruskal-Wallis $H$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarity of Organizational Goals</td>
<td>0.81</td>
<td>.668</td>
</tr>
<tr>
<td>Efficiency in Communication</td>
<td>0.68</td>
<td>.713</td>
</tr>
<tr>
<td>Effective Working Relationships</td>
<td>0.18</td>
<td>.915</td>
</tr>
<tr>
<td>Efficiency in Planning and Scheduling</td>
<td>0.61</td>
<td>.739</td>
</tr>
<tr>
<td>Clarity of Roles and Responsibilities</td>
<td>2.57</td>
<td>.276</td>
</tr>
<tr>
<td>Efficiency in Processes</td>
<td>0.92</td>
<td>.630</td>
</tr>
<tr>
<td>Budgetary Aspects of Affordability</td>
<td>0.35</td>
<td>.841</td>
</tr>
</tbody>
</table>
4.6.3 Establishing Within-Group Agreement for Years at NASA Categories

Within-group interrater agreement was assessed for agreement across affordability groupings per categories of years employed at NASA. For the interrater agreement analysis of the differing year categories (0-9, 10-19, 20-29, 30-39, 40-49), the year category of 40-49 was excluded as there were only two observations in this category. Results indicate that interrater agreement is of an acceptable level for all categories, with the exception of the category 10-19 years being slightly below the suggested 0.70 cutoff value. Even with the lower $r_{WG}$ value seen with those employed at NASA for 10-19 years, all job categories were considered to have at least moderate agreement, with most being considered to have strong agreement. For $r_{WG}$ values per years at NASA category, see Table 4.4.

Table 4.4 Interrater Agreement Estimates per Years at NASA Category. This table shows significance levels for group comparisons of affordability grouping ratings when examining years employed at NASA category.

<table>
<thead>
<tr>
<th>Years at NASA Category</th>
<th>$r_{WG}$ mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9 years</td>
<td>0.75</td>
</tr>
<tr>
<td>10-19 years</td>
<td>0.69</td>
</tr>
<tr>
<td>20-29 years</td>
<td>0.70</td>
</tr>
<tr>
<td>30-39 years</td>
<td>0.73</td>
</tr>
</tbody>
</table>

4.6.4 Affordability Grouping by Years at NASA Comparison

Respondents were also categorized into five categories describing length of time employed at NASA: 0-9 years, 10-19 years, 20-29 years, 30-39 years, and 40-49 years.
Two responses indicated time lengths that were not exact, such as “20+ years” and “30+ years”. These responses were considered to have been within the 20-29 year and 30-39 year range, respectively. One answer of “many” was excluded from data analysis as it could not be adequately determined which year category was appropriate. When analyzing group differences for ratings based on years at NASA, the grouping of “40-49” was excluded as there were only two observations.

A Kruskal-Wallis test was performed on the composite scores of the four groups (0-9 years at NASA, 10-19 years at NASA, 20-29 years at NASA, 30-39 years at NASA). For questions within the Clarity of Organizational Goals affordability group, the differences between the rank totals of 88.64 (0-9 years), 74.01 (10-19 years), 93.31 (20-29 years), and 88.96 (30-39 years) were non-significant, $H(3, n = 169) = 3.86, p = .277$.

For questions within the Efficiency in Communication affordability group, the differences between the rank totals of 92.27 (0-9 years), 77.49 (10-19 years), 79.23 (20-29 years), and 89.53 (30-39 years) were non-significant, $H(3, n = 169) = 2.82, p = .420$.

For questions within the Effective Working Relationships affordability group, the differences between the rank totals 94.43 (0-9 years), 77.64 (10-19 years), 81.50 (20-29 years), and 87.19 (30-39 years) were non-significant, $H(3, n = 169) = 2.71, p = .440$.

For questions within the Efficiency of Planning and Scheduling affordability group, the differences between the rank totals 95.17 (0-9 years), 70.42 (10-19 years), 81.48 (20-29 years), and 93.00 (30-39 years) were non-significant, $H(3, n = 169) = 7.77, p = .051$.

For questions within the Clarity of Roles and Responsibilities affordability group, the differences between the rank totals of 92.40 (0-9 years), 76.78 (10-19 years), 80.00 (20-29 years), and 89.75 (30-39 years) were non-significant, $H(3, n = 169) = 3.05, p = .384$. 

71
For questions within the Efficiency of Processes affordability group, the differences between the rank totals of 101.19 (0-9 years), 78.43 (10-19 years), 82.75 (20-29 years), and 81.99 (30-39 years) were non-significant, $H (3, n = 169) = 5.04, p = .169$. For questions within the Budgetary Aspects affordability group, the differences between the rank totals 104.37 (0-9 years), 73.51 (10-19 years), 75.21 (20-29 years), and 87.42 (30-39 years) were significant, $H (3, n = 169) = 9.431, p = .024$.

Results from this test indicated a significant difference in the distribution of Likert ratings between groups for questions within the Budgetary Aspects of Affordability grouping, thus partially supporting Hypothesis 3 (see Table 4.5). A box plot was created to visually evaluate where group differences existed within the years at NASA categories when prompted regarding budgetary aspects of affordability (see Figure 4.8).

Table 4.5 Independent Samples Comparison of Affordability Aspects by Years at NASA. This table shows significance levels for group comparisons of affordability grouping ratings when examining years employed at NASA.

<table>
<thead>
<tr>
<th>Affordability Grouping</th>
<th>Kruskal-Wallis $H$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarity of Organizational Goals</td>
<td>3.86</td>
<td>.277</td>
</tr>
<tr>
<td>Efficiency in Communication</td>
<td>2.82</td>
<td>.420</td>
</tr>
<tr>
<td>Effective Working Relationships</td>
<td>2.71</td>
<td>.439</td>
</tr>
<tr>
<td>Efficiency in Planning and Scheduling</td>
<td>7.77</td>
<td>.051</td>
</tr>
<tr>
<td>Clarity of Roles and Responsibilities</td>
<td>3.05</td>
<td>.384</td>
</tr>
<tr>
<td>Efficiency in Processes</td>
<td>5.04</td>
<td>.169</td>
</tr>
<tr>
<td>Budgetary Aspects of Affordability</td>
<td>9.43</td>
<td>.024</td>
</tr>
</tbody>
</table>
Figure 4.8 Median Rating for Budgetary Aspects of Affordability Grouping per Years at NASA. This figure depicts the group differences in affordability Likert ratings depending on years employed at NASA. Respondents within the 0-9 years group responded with more neutrality than when compared to the 10-19, 20-29 and 30-39 year groups.

Median values per years employed at NASA category are as follows: 0-9 years, 4.33; 10-19 years, 3.00; 20-29 years, 3.17; 30-39 years, 3.33. In general, when responding to questions regarding budgetary aspects of affordability, those that have worked at NASA 0-9 years tend to be more neutral in their perceptions, or even leaning towards slightly positive. Those that have worked for NASA for 10-19 years, 20-29 years, and 30-39 years are similar in their perceptions regarding budgetary aspects of affordability, indicating slightly negative responses in general. This difference in perception may possibly be attributed to the lack of experience and involvement one may have early in their career. Those earlier in their careers at NASA may have less of an opinion or knowledge regarding budgetary aspects of affordability therefore resulting in a more neutral opinion whereas those who have been with the organization longer may tend to view budgetary aspects of affordability more negatively. Group differences in
Likert ratings per budgetary aspects of affordability question can be seen in Figure 4.9.

For a more detailed analysis of budgetary results, see Appendix F.

Figure 4.9 Distribution of Responses to Budgetary Aspects of Affordability Questions by Years at NASA. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.

4.7 Quantitative Analysis: Demographic Group Comparison of Affordability

Aspects for NASA, Industry, and Students

In order to examine any potential group differences in perceptions regarding affordability, a between-group comparison was conducted using student, industry, and NASA employee responses to Likert scale questions within each affordability grouping. A Kruskal-Wallis $H$ test was utilized for each affordability grouping and results can be seen in Table 4.6 along with the average median for each affordability grouping per
demographic group. A Kruskal-Wallis test was performed on the composite scores of the three groups (students, industry, NASA).

For questions within the Clarity of Organizational Goals affordability group, the differences between the rank totals of 182.53 (student), 181.86 (industry), and 165.44 (NASA) were non-significant, $H (2, n = 347) = 2.49, p = .288$. For questions within the Efficiency in Communication affordability group, the differences between the rank totals of 173.20 (student), 172.83 (industry), and 174.88 (NASA) were non-significant, $H (2, n = 347) = 0.03, p = .987$. For questions within the Effective Working Relationships affordability group, the differences between the rank totals of 168.94 (student), 181.80 (industry), and 176.76 (NASA) were non-significant, $H (2, n = 347) = 0.69, p = .708$. For questions within the Efficiency in Planning and Scheduling affordability group, the differences between the rank totals of 209.69 (student), 194.45 (industry), and 140.53 (NASA) were non-significant, $H (2, n = 347) = 5.86, p = .053$. For questions within the Clarity of Roles and Responsibilities affordability group, the differences between the rank totals of 182.21 (student), 171.53 (industry), and 167.63 (NASA) were non-significant, $H (2, n = 347) = 1.67, p = .433$. For questions within the Efficiency in Processes affordability group, the differences between the rank totals of 187.97 (student), 193.03 (industry), and 158.84 (NASA) were significant, $H (2, n = 347) = 7.88, p = .019$. For questions within the Budgetary Aspects affordability group, the differences between the rank totals of 229.92 (student), 162.53 (industry), and 129.64 (NASA) were significant, $H (2, n = 347) = 79.26, p = .000$. 

75
Table 4.6 Independent Samples Comparison of Likert Ratings for NASA, Industry, and Students. This table depicts the group differences for Likert ratings of affordability aspects as well as significance values and median answer for each demographic group.

<table>
<thead>
<tr>
<th>Affordability Grouping</th>
<th>Kruskal-Wallis $H$</th>
<th>$p$</th>
<th>NASA Median</th>
<th>Industry Median</th>
<th>Student Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarity of Organizational Goals</td>
<td>2.49</td>
<td>.288</td>
<td>Slightly Agree</td>
<td>Slightly Agree</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td>Efficiency in Communication</td>
<td>0.27</td>
<td>.987</td>
<td>Slightly Agree</td>
<td>Slightly Agree</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td>Effective Working Relationships</td>
<td>0.69</td>
<td>.708</td>
<td>Slightly Agree</td>
<td>Slightly Agree</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td>Efficiency in Planning and Scheduling</td>
<td>5.86</td>
<td>.053</td>
<td>Slightly Disagree</td>
<td>Slightly Disagree</td>
<td>Neutral</td>
</tr>
<tr>
<td>Clarity of Roles and Responsibilities</td>
<td>1.67</td>
<td>.433</td>
<td>Slightly Agree</td>
<td>Slightly Agree</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td>Efficiency in Processes</td>
<td>7.88</td>
<td>.019</td>
<td>Slightly Agree</td>
<td>Slightly Agree</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td>Budgetary Aspects of Affordability</td>
<td>79.26</td>
<td>.000</td>
<td>Slightly Disagree</td>
<td>Neutral</td>
<td>Slightly Agree</td>
</tr>
</tbody>
</table>

A significant group difference was seen for the Efficiency in Processes and Budgetary Aspects of Affordability groupings when the student, industry, and NASA responses were compared. When examining average medians, one can see group differences in the Budgetary Aspects grouping in Table 4.6. Though no group difference in average medians is seen for the Efficiency in Processes grouping, differences in medians can be seen for individual significant questions. Due to the significant results, an additional Kruskal-Wallis $H$ test was conducted for each individual question within the Efficiency in Processes and Budgetary Aspects of Affordability groupings to examine
which questions specifically resulted in significant group differences. Questions from this additional analysis that resulted in significant $p$ values can be seen in Table 4.7.

Table 4.7 Individual Questions with Significant Group Differences. This table depicts significant questions within the Efficiency in Processes and Budgetary Aspects of Affordability groups.

<table>
<thead>
<tr>
<th>Affordability Grouping</th>
<th>Question</th>
<th>Kruskal-Wallis $H$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency in Processes</td>
<td>Processes can be quickly tailored to meet new conditions and solve problems as they arrive.</td>
<td>34.56</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Management is interested in deploying efficiency processes.</td>
<td>7.54</td>
<td>.023</td>
</tr>
<tr>
<td></td>
<td>The processes within your program have never changed.</td>
<td>10.16</td>
<td>.006</td>
</tr>
<tr>
<td></td>
<td>Methods to get the job done more efficiently are often discussed in your program.</td>
<td>6.84</td>
<td>.033</td>
</tr>
<tr>
<td>Budgetary Aspects of Affordability</td>
<td>Your program rarely stays within its fiscal year budget.</td>
<td>21.51</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Your program budget is realistic.</td>
<td>31.09</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Your program is likely to experience cost overruns.</td>
<td>74.16</td>
<td>.000</td>
</tr>
</tbody>
</table>

To further understand potential group differences for each of these significant affordability questions, response distributions for each significant question were generated to compare group responses and can be seen in Figures 4.10 and 4.11.

Corresponding mean ranks and median values can be found in associated Tables 4.8 and 4.9.
Figure 4.10 Significant Efficiency in Processes Questions. This figure shows the response distribution per demographic group for questions within the Efficiency in Processes affordability group. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.

When one examines response distributions for the question regarding methods to get the job done, student responses resulted in a slightly more positive skew than industry members and NASA responses. When one examines the distribution of responses
regarding processes never changing, industry responses resulted in a more positive skew as compared to NASA and student responses. A similar skew was seen for the question regarding management interest in deploying efficient processes. When NASA participants were prompted regarding process adaptability, their responses resulted in a more negative skew than industry and student responses. For group mean ranks and median values of each question, see Table 4.8.
Table 4.8 Mean Rank Differences for Process Questions. This table depicts the group differences in Efficiency in Processes questions for each demographic group along with median ratings.

<table>
<thead>
<tr>
<th>Efficiency in Processes Question</th>
<th>Group</th>
<th>Mean Rank</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processes can be quickly tailored to meet new conditions and solve problems as they arrive.</td>
<td>Student</td>
<td>209.03</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>181.56</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td></td>
<td>NASA</td>
<td>143.47</td>
<td>Slightly Disagree</td>
</tr>
<tr>
<td>Management is interested in deploying efficient processes.</td>
<td>Student</td>
<td>174.16</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>217.06</td>
<td>Agree</td>
</tr>
<tr>
<td></td>
<td>NASA</td>
<td>165.85</td>
<td>Agree</td>
</tr>
<tr>
<td>The processes within your program have never changed.</td>
<td>Student</td>
<td>157.23</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>213.45</td>
<td>Agree</td>
</tr>
<tr>
<td></td>
<td>NASA</td>
<td>180.60</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td>Methods to get the job done more efficiently are often discussed in your program.</td>
<td>Student</td>
<td>188.88</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>180.89</td>
<td>Agree</td>
</tr>
<tr>
<td></td>
<td>NASA</td>
<td>160.34</td>
<td>Slightly Agree</td>
</tr>
</tbody>
</table>
Figure 4.11 Significant Budgetary Aspects of Affordability Questions. This figure shows the response distribution per demographic group for questions within Budgetary Aspects affordability group. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.

When one examines response distributions for the question regarding cost overruns, student responses resulted in a normal distribution while NASA and industry responses had a highly negative skew in distributions. When one examines the distribution of responses regarding realistic budgets, student responses resulted in a slightly more positive skew while industry members and NASA responses tended to be more neutral. When students were prompted regarding the fiscal year budget, their responses resulted in a slightly more positive skew than industry members and NASA responses. For group mean ranks and median values of each question, see Table 4.9.
Table 4.9 Mean Rank Differences for Budgetary Aspects Questions. This table depicts the group differences in Budgetary Aspects of Affordability questions for each demographic group along with median ratings.

<table>
<thead>
<tr>
<th>Budgetary Aspects Question</th>
<th>Group</th>
<th>Mean Rank</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your program budget is likely to experience cost overruns.</td>
<td>Student</td>
<td>226.32</td>
<td>Neutral</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>175.08</td>
<td>Slightly disagree</td>
</tr>
<tr>
<td></td>
<td>NASA</td>
<td>130.30</td>
<td>Disagree</td>
</tr>
<tr>
<td>Your program budget is realistic.</td>
<td>Student</td>
<td>208.64</td>
<td>Slightly Agree</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>164.63</td>
<td>Neutral</td>
</tr>
<tr>
<td></td>
<td>NASA</td>
<td>146.94</td>
<td>Neutral</td>
</tr>
<tr>
<td>Your program rarely stays within its fiscal year budget.</td>
<td>Student</td>
<td>202.76</td>
<td>Neutral</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>165.09</td>
<td>Neutral</td>
</tr>
<tr>
<td></td>
<td>NASA</td>
<td>151.74</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

Given the significant group differences seen in questions within the Efficiency in Processes and Budgetary Aspects of Affordability groupings, results indicate partial support for Hypothesis 5. Group differences can be seen within ratings of certain organizational aspects related to affordability, but not necessarily all aspects included in this study. Students tended to have a more positive perception of affordability overall when compared to NASA and industry regarding engineering processes and finances. As stated earlier, these differences may potentially be due to a lack of familiarity or social
desirability. Industry members and NASA employees tend to be either more neutral or slightly negative in perceptions regarding current affordability practices.
Chapter 5. Discussion

The cultural expectations prioritized in organizations can inform organizational members of overall organizational goals and values and how to best achieve those goals. Oftentimes, organizations may aim to operate in a way that would be considered affordable, though a consensus of what “affordability” entails in an organization can be lacking. To some organizations, affordability is concerned with cost versus available financial resources, essentially indicating that something that is not affordable would place a financial burden on the person or organization (Litman, 2017; Moodie-Dyer, 2011; Temple, 2008). Other organizations have looked at affordability in terms of lifecycle cost in conjunction with long range investment capabilities (Bankole et al., 2009; Defense Acquisition Guidebook, 2013) or just simply staying within a budget (Emmons et al., 2010). While financial resources are large determinants of an organization’s capabilities, considerations outside of monetary aspects can impact the overall affordability of a project or program. Non-monetary considerations have been linked to affordability, with previous research citing schedule of development and responsiveness to emerging needs as factors impacting affordability (Schaffner, 2013). These organizational behaviors are not directly related to budgets and funding, though they have the ability to impact perceptions of affordability due to increased costs linked with schedule extensions (Ahmed et al., 2002; Chidambaram et al., 2012) and reorganization costs (Verdu & Gomez-Gras, 2009). Though budgets and funding are important when evaluating affordability, solely focusing on these financial considerations
may cause organizations to overlook organizational behaviors impacting the overall affordability of a project or program. Given the significance of affordable practices to practitioners, the aim of the current study was to understand the presence of organizational aspects associated with an affordability culture beyond financial considerations. Specifically, organizational behaviors that have been shown in research to directly impact the financial standing of a company were examined to understand how these aspects may contribute to an affordability culture within an organization. Survey data were collected on participants’ subjective experiences, beliefs, and preferences regarding affordability within their current organizations through a series of both open-ended and closed-ended questions.

Research Question 1 focused on affordability definitions and the potential presence of non-monetary considerations (When defining affordability, are non-monetary aspects of affordability featured in participant responses?). Definitions given by each of the three groups (students, industry, NASA) featured non-monetary aspects to some degree, with NASA respondents given definitions that most frequently featured non-monetary aspects. While affordability definitions still discuss budgets and funding the majority of the time, non-monetary considerations were included when defining affordability, supporting Hypothesis 1. These non-monetary considerations can include temporal factors such as time or schedule, as seen in previous research by Schaffner (2013). Extending beyond temporal aspects, this research identified non-monetary considerations including requirements specification (such as design and safety), program sustainability, and workforce or material resources featured in definitions of affordability. The way organization members define affordability may potentially affect the
implementation of an affordability culture. If organization members are defining affordability by just focusing on budget or funding, the individual impact of organization members on affordability practices is not taken into consideration. In that sense, affordability is something that happens to organizations by having a large budget or ample funding rather than something that organizations can directly impact or change. By defining affordability just in terms of finances, members can potentially remove any sense of direct impact or contribution to the affordability of an organization, placing the burden of affordability on funding agencies. Organizations that are evaluating affordability solely in terms of financial considerations may benefit from change management introducing a change of mindset regarding the impact of personal and organizational behaviors on affordability.

Research Question 2 focused on affordability perceptions within one organizational unit (How do NASA employees perceive affordability?). Perspectives of affordability given by NASA MSFC employees allowed for insight into beliefs surrounding affordability within a singular, government-funded organization utilizing a use-it-or-lose-it (also known as expiring) budget. Findings revealed that NASA employees suggested organization-based interventions when prompted regarding affordability improvement more frequently than engineering process improvements or financial improvements. NASA employees more frequently indicated organizational benefits as reasons for wanting an affordability culture as opposed to engineering process benefits or financial benefits. When evaluating affordability within the organization, NASA employees tended to respond in ways that suggested organizational change and development, as opposed to engineering process adjustments or financial alternatives.
These results suggest that NASA employees are taking into consideration the direct impact that organization members have on affordability through current behaviors. This may indicate the presence of a direct impact to affordability, as opposed to evaluating affordability in terms of something situational, determined by current financial resources or engineering processes.

Quantitative analyses revealed that though no significant difference was seen for Likert scale ratings of organizational aspects between the job categories (not supporting Hypothesis 2), a significant difference was seen when evaluating Budgetary Aspects of Affordability questions against years employed at NASA (partially supporting Hypothesis 3). For those employed at NASA MSFC for 0-9 years, responses resulted in normal distributions for both significant questions regarding cost overruns and fiscal year budget, indicating neutrality in perceptions. Responses from those employed at NASA MSFC for 10-19 years indicated a belief that the program was not likely to experience cost overruns and that the program was not likely to stay within its fiscal year budget. This appears to be counterintuitive, as the responses are suggesting that the program is both not likely to experience overruns but is likely to experience overruns within the fiscal budget. Perhaps the fiscal year qualifier could explain this difference, with respondents believing that it may not be likely to stay under budget within a fiscal year, but the program as a whole will still not experience cost overruns over the course of time. Both the 20-29 years and the 30-39 years employed at NASA MSFC had similar response patterns. Both groups had responses that indicated the belief that their program is not likely to experience cost overruns while simultaneously having a normal distribution regarding the program staying within the fiscal year budget. Participants may be neutral
in opinions of the fiscal year budget but are more confident in not overrunning the overall program budget. These results indicate that employment length at organizations and experience may have an impact on perceptions of affordability in an organization when prompted regarding staying within a fiscal year budget and cost overruns. These results also suggest that perceptions of affordability within one organization can significantly differ, indicating that group differences may exist in perceptions.

Research Question 3 focused on affordability across a variety of organizations (How is affordability perceived across various demographic populations?). Perspectives of affordability given by industry members, student respondents, and NASA MSFC employees allowed for insight into beliefs surrounding affordability across various organizations (both government and non-government) utilizing various types of budgets. Qualitative thematic analysis revealed significant group differences when prompted regarding affordability improvement, why an individual would want an affordability culture, and what cultural barriers may exist within an individual’s organization hindering affordability. NASA and industry were similar in response patterns, with both groups suggesting organizational approaches as interventions to improve affordability, reasons why an affordability culture would be wanted, and potential hindrances to an affordability culture. One notable difference was that NASA respondents suggested engineering interventions and justifications more frequently than industry members and student members. Students rarely suggested engineering process approaches, but rather focused on financial interventions or improvements. NASA employees appear to perceive affordability in terms of organizational efforts in a similar fashion as industry members, with slightly more emphasis on engineering processes. As NASA places importance on
science, technology, engineering, and math, it is not surprising that some intervention suggestions encompass these sorts of domains. These results indicate that students tend to perceive affordability in terms of finances, but as organization members are employed for longer lengths of time and are further along in their careers, interventions and approaches to affordability tend to shift more to focusing on organizational behaviors and impact. Industry members responded in similar patterns to prompts regarding affordability as NASA respondents, indicating similar beliefs regardless of potentially varying budget type (i.e., expiring budgets such as use-it-or-lose-it budgets and non-expiring budgets) or possible government affiliation (government and non-government). Given these results, it appears as if organization members are less focused on the financial constraints on the organization, with budget playing less of a role in affordability perceptions, and instead focused on the organizational behaviors and practices when evaluating current affordability approaches.

Quantitative analyses indicated a significant group difference when evaluating questions regarding efficiency in processes and budgetary aspects of affordability. As a whole, NASA MSFC employees tended to respond in more neutral and sometimes more negative patterns as compared to industry members and student respondents. Student respondents generally provided more positive responses regarding budgets and engineering processes. These positive perceptions may be due to an overly optimistic view of affordability due to a lack of experience or familiarity or could potentially be attributed to social desirability factors, responding in ways that would seem positive to the researcher. Given the unique position of NASA as a government-funded agency encouraged to practice affordability due to stewardship but then constrained by use-it-or-
lose-it budgets, employees at NASA MSFC may be conflicted in opinions regarding current affordability practices, resulting in a more neutral opinion overall. Though many organizational components resulted in non-significant group differences, these results are still considered important due to implications of similar perceptions. As no significant group differences were found in perceptions of affordability surrounding non-monetary aspects such as organizational goals, communication, working relationships, planning and scheduling, and roles and responsibilities, results suggest that as a whole, perceptions across various demographic groups surrounding these non-monetary organizational behaviors align with one another. Differences may exist in perception on an item-level, and organizations may be interested in evaluating perceptions on the item-level to pinpoint areas that may need extra attention from the organization. Perceptions surrounding non-monetary considerations indicated no significant group differences in responses, indicating that industry may have the same issues as NASA in terms of organizational behaviors impacting affordability.

5.1 Organizational Components of Affordability Culture

The findings from this study build upon the widely used OCM and POCF to capture the factors associated with an affordability culture. Using the OCM (Patterson et al., 2005) and POCF (Nguyen & Watanabe, 2017) as a foundation, adaptations were made to questions in addition to the creation of new questions to evaluate an organization’s current practices with an emphasis on affordability. For instance, the OCM decomposes an organization’s climate into various dimensions to evaluate perceptions regarding current practices in an organization given by organization members. The POCF takes a similar approach, analyzing an organization’s cultural framework by examining
cultural artifacts that contribute to the overall values and beliefs held by an organization. The proposed model utilized in the current study confirms attributes associated with organizational culture and climate, such as budgetary perceptions featured in the POCF, and efficiency as featured in the OCM (see Figure 5.1). Together with the results from the survey data, this information was applied to propose a model decomposing an organization into components associated in literature with the overall affordability of a project or program. This allowed for the evaluation of organizational behaviors in similar fashions to previously validated measures but with specific emphasis on the components that comprise an affordability culture.

Figure 5.1 Significant Organizational Components of an Affordability Culture. Green highlights indicate organizational components which resulted in significant group differences in perception.
5.2 Application to Practitioner

The affordability survey utilized in this study shed light on current practices regarding affordability and behaviors potentially contributing to an affordability culture. This survey decomposes an organization into multiple components that may each individually contribute to the overall affordability of an organization or program. This decomposition allows for a deeper understanding of where an organization currently stands in terms of affordability in behavior-specific groupings as opposed to simply evaluating available financial resources against costs of operations. By examining affordability in these components, organizations may be able to pinpoint specific areas in which organizational change and development may occur to align current practices with desired behaviors. Organizations may choose to focus on each of these groups in conjunction with one another or may choose to focus on one organizational component of affordability culture depending on organizational needs.

Data collected from NASA MSFC employees can be used as an example of how practitioners can evaluate perceptions of an affordability culture within a singular organization. Utilizing the frequency count data regarding perceptions of organizational behaviors, areas of strength and opportunity can be identified. For example, frequency counts of Likert data responses regarding organizational behaviors given by NASA MSFC employees indicated areas of strength within current practices, areas of opportunity in which organizational change may occur to improve current practices, and areas in which no clear consensus was generated by organization members. Areas of strength within NASA MSFC as suggested by employees included commitment to and
interest in affordability as an organizational goal, efficient communication behaviors within the organization, effective interpersonal relationships among organization members, efficient internal planning and scheduling, and adequate clarity of roles and responsibilities of those involved with the organization. Areas of opportunity in which organizational development may be encouraged to improve current practices included the overall prioritization of affordability as an organizational goal within NASA MSFC, inclusion of team member input on decisions impacting affordability, and modernization of engineering processes within the organization. Areas in which no clear consensus was reached amongst the organization members included external planning and scheduling by those outside of the immediate organization as well as perceptions regarding NASA’s needs. Response distributions to prompts related to NASA’s needs suggest that participants both believe and simultaneously do not believe that NASA’s needs are considered a top priority. These questions were included as an attention check, and it appears as if participants did not realize the difference in wording between the questions. These results may indicate areas within the organization in which practitioners may implement organizational change and development to better align current practices with an affordability culture.

Data collected from student respondents indicated a lack of familiarity with the concept of affordability within an organization. When participants were prompted regarding affordability definitions, affordability improvement, cultural wants, and cultural barriers, almost half of responses given for each question suggested that respondents did not understand what was being asked of them. Student responses appeared to be less confident in their responses surrounding affordability, which may also
explain why 67 student respondents explicitly asked for their data to not be included in analyses (as opposed to two respondents from NASA and three respondents from industry). Employees that may have recently graduated from college or are early in their careers may not understand the concept of affordability within an organization as well as the idea of organizational culture. Organizations may benefit from covering these concepts during onboarding processes to ensure new hires understand how affordability is approached within their organizations as well as what is expected of them in terms of organizational culture.

5.3 Limitations and Future Work

Limitations of the current study include sample size and sample population. As the goal of the study was to understand affordability culture in industry, ideally participant responses would come solely from industry members to compare to NASA perceptions. Given the lack of survey response by industry members recruited, student participation was included in order to meet minimum requirements for sample sizes. Typically, college students are acquiring a degree to attain a job within a desired career and are not currently employed in their long-term careers while attending university. Given the lack of experience and familiarity with organizational processes, students are not the most appropriate sample for a survey intended for industry members and NASA employees. Most questions in this survey were evaluating affordability from an industry perspective, so though student responses were able to be analyzed, they were not the ideal sample to allow for generalizability of results. Future research would aim not to include student responses and direct more recruitment efforts towards industry members. Given the inclusion of student responses as well as the small sample size, the affordability
culture model proposed in this research (see Figure 2.2) is not able to be validated; therefore, future iterations of this research will focus on the validation of this model with a larger, more appropriate sample size.

Another limitation of the study was utilizing a survey research approach. Long surveys can result in participant fatigue, which can in turn impact response behaviors by participants. A portion of survey data was excluded due to obvious participant fatigue, where empty answers and the same singular answer given throughout the entirety of the survey was observed. As students were incentivized to complete the survey for course credit, a portion of student respondents simply finished the survey for credit and then opted to have data excluded from analyses. This could be due to a lack of effort in responses or a lack of confidence in responses given. Future work will consider survey length and completion time prior to distribution in order to reduce participant fatigue. Future research may also only utilize specific sections of the survey dependent upon research interests and goals.

A final limitation of the study is the nature of affordability in organizations. Many organizations consider processes, both engineering and organizational, to be proprietary or confidential information and are not open to sharing beliefs regarding current affordability practices. As this survey was part of NASA-funded research, NASA employees were encouraged to take the survey and could potentially have felt more comfortable expressing opinions and beliefs. As industry members did not have this encouragement from higher in the organizational hierarchy, they may have been more apprehensive to share opinions regarding affordability, specifically opinions that may suggest negative perspectives towards current practices. Future work would benefit from
potentially trying to distribute the survey through a Human Resources Department or management to alleviate any potential apprehension from employees.

5.4 Conclusion

The type of culture present in organizations determines the values and beliefs held by the organization which in turn impact day-to-day operations seen in organizational climate. Subcultures can exist within organizations, emphasizing specific goals such as safety or affordability. When an attempt is made to evaluate an organization’s current affordability practices, climate can be measured across various non-monetarily focused organizational domains, such as clarity of organizational goals, efficiency in communication, effective working relationships, efficiency in planning and scheduling, clarity of roles and responsibilities, efficiency in processes, as well as budgetary aspects of affordability. When current affordability practices between NASA MSFC employees, industry members, and student responses are compared, industry and NASA typically suggest organizational interventions and benefits while students typically evaluate current funding allocations and budgets. NASA evaluations of affordability practices were typically less optimistic as compared to industry and student respondents. Significant group differences were seen when budgets and funding as well as efficiency in processes were evaluated. When one evaluates affordability culture in industry, group differences may be seen dependent upon organization type or career length, with more experienced employees having less optimistic evaluations. This study contributes to a growing body of literature surrounding affordability culture as an emerging subculture in industry.
References


Gajendran, R. S., & Joshi, A. (2012). Innovation in globally distributed teams: The role of LMX, communication frequency, and member influence on team decisions.


Appendix A. Affordability Survey

Open-Ended Questions

Please answer all following questions with regards to the program you personally work on.

1. What does affordability mean to you?
2. What would you do if you were asked to improve the affordability of the program you are currently working on?
3. What cultural barriers potentially hindering affordability have you encountered in your program?
4. Why would you want an affordability culture in your program?

Closed-Ended Questions

Please answer the following questions in regard to your personal opinion about the topics discussed. Please answer based on your current project. Please rank the items as follows:

(1) Strongly Disagree (2) Disagree (3) Slightly Disagree (4) Neutral (5) Slightly Agree (6) Agree (7) Strongly Agree

1. Most people on your program have input into the decisions that affect the affordability of the program you are currently working on.
2. Cooperation and collaboration across positions and departments are actively sought to make your program stay within budget.
3. Your program is likely to experience cost overruns.
4. Your program budget is realistic.
5. Your program rarely stays within its fiscal year budget.
6. I believe the organization’s top priority is making programs more affordable.
7. When you make decisions impacting affordability, the organization’s needs are considered top priority.

8. When you make decisions impacting affordability, the organization’s needs are not considered top priority.

9. Stakeholders share a high degree of commitment in making your program affordable with regard to costs. Stakeholders are defined as people who impact or are impacted by the program. Such people may include engineers, administration, marketing, Congress, the general public, etc.

10. Information is shared, transparent, and available for stakeholders in the program you are currently working on.

11. Project managers provide clear communication, assistance, and support to their subordinates.

12. There is clear communication from the engineers to the program managers.

13. There are often breakdowns in communication within your program.

14. Methods to get the job done more efficiently are often discussed in your program.

15. Assigning blame and accountability issues are very common when things go wrong.

16. All program stakeholders are viewed as important contributors to your program’s success.

17. Stakeholders are empowered to make decisions to improve overall program affordability.

18. Stakeholders share a high degree of commitment to making the program successful.
19. There is a high level of agreement about the way things are done in the program.
20. Stakeholder comments and recommendations are actively sought regarding system affordability in your program.
21. The processes within your program have never changed.
22. Management is interested in deploying efficient processes.
23. Management is interested in creating an affordable system.
24. Processes can be quickly tailored to meet new conditions and solve problems as they arrive.
25. Industry is slow to respond to the needs of your organization.
26. Your organization looks for new opportunities to make programs more affordable.
27. You have a good understanding of how the program aims to adopt a culture towards affordability.
28. Planned development timeline, cost, and performance could be met if work were better organized.
29. Program performance is measured on a regular basis.
30. People on your program clearly understand what roles and duties are required of them to make the program affordable.
31. People on your program understand their impact on the affordability of the program and mission.
32. Program leaders always make sure that their subordinates know what is expected of them.
33. Your program has a long-term purpose and direction.
34. There are effective working relationships among stakeholders that allow program milestones to be met.

35. Stakeholders are willing to exchange ideas and help each other to meet deadlines.

36. Stakeholders deliver products on time.

37. Poor scheduling and planning often results in targets not being met.

**Ranking Questions**

For the following questions, please rank the Life-Cycle Phases by dragging the slider OR clicking the position on the scale that best represents your personal opinion. If you wish to indicate “1”, please click the slider indicator so that a “1” appears.

Please choose the life-cycle phase that best aligns with your organization.

- **Generic Life Cycle:** Concept Stage, Development Stage, Production Stage, Utilization Stage, Support Stage, Retirement Stage

- **Typical High-Tech Commercial Systems Integrator:** Study Period (User Requirements Definition Phase, Concept Definition Phase, System Specification Phase, Acquisition Prep Phase), Implementation Period (Source Select Phase, Development Phase, Verification Phase), Operations Period (Deployment Phase, Operations and Maintenance Phase, Deactivation Phase)

- **Typical High-Tech Commercial Manufacturer:** Study Period (Product Requirements Phase, Product Definition Phase, Product Development Phase), Implementation Period (Engineer Model Phase, Internal Test Phase, External Test Phase), Operations Period (Full-Scale Production Phase, Manufacturing/Sales/Support Phase, Deactivation Phase)
• US Department of Defense: Pre-Systems Acquisition (Material Solution Analysis, Technology Development), Systems Acquisition (Engineering and Manufacturing Development, Production and Deployment), Sustainment (Operations and Support)

• NASA: Pre Phase A (Concept Studies), Phase A (Concept & Technology Development), Phase B (Primary Design & Technology Completion), Phase C (Final Design & Fabrication), Phase D (System Assembly Integration, Test, and Launch), Phase E (Operations and Sustainment), Phase F (Closeout)

### Appendix B. Survey Question Sources

**Table B.1** Affordability Survey Question Sources. This table depicts each question featured within the affordability survey and the original source from which the question was adapted.

<table>
<thead>
<tr>
<th>Question</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>What does affordability mean to you?</td>
<td>Generated by research group</td>
</tr>
<tr>
<td>What would you do if you were asked to improve the affordability of the program you are currently working on?</td>
<td>Generated by research group</td>
</tr>
<tr>
<td>What cultural barriers potentially hindering affordability have you encountered in your program?</td>
<td>Generated by research group</td>
</tr>
<tr>
<td>Why would you want an affordability culture in your program?</td>
<td>Generated by research group</td>
</tr>
<tr>
<td>Most people on your program have input into the decisions that affect the affordability of the program you are currently working on.</td>
<td>Adapted from OCM</td>
</tr>
<tr>
<td>Cooperation and collaboration across positions and departments are actively sought to make your program stay within budget.</td>
<td>Adapted from OCM</td>
</tr>
<tr>
<td>Your program is likely to experience cost overruns.</td>
<td>Generated by research group</td>
</tr>
<tr>
<td>Your program budget is realistic.</td>
<td>Generated by research group</td>
</tr>
<tr>
<td>Your program rarely stays within its fiscal year budget</td>
<td>Generated by research group</td>
</tr>
<tr>
<td>I believe the organization’s top priority is making programs more affordable.</td>
<td>Generated by research group</td>
</tr>
<tr>
<td>When you make decisions impacting affordability, the organization’s needs are considered top priority.</td>
<td>Adapted from OCM</td>
</tr>
<tr>
<td>When you make decisions impacting affordability, the organization’s needs are not considered top priority.</td>
<td>Adapted from OCM</td>
</tr>
<tr>
<td>Stakeholders share a high degree of commitment in making your program affordable with regard to costs.</td>
<td>Adapted from POCF</td>
</tr>
<tr>
<td>Information is shared, transparent, and available for stakeholders in the program you are currently working on.</td>
<td>Adapted from POCF</td>
</tr>
<tr>
<td>Project managers provide clear communication, assistance, and support to their subordinates.</td>
<td>Adapted from POCF</td>
</tr>
</tbody>
</table>
There is clear communication from engineers to the program managers.  
Generated by research group

There are often breakdowns in communication within your program.  
Adapted from OCM

Methods to get the job done more efficiently are often discussed in your program.  
Adapted from OCM

Assigning blame and accountability issues are very common when things go wrong.  
Adapted from POCF

All program stakeholders are viewed as important contributors to your program’s success.  
Adapted from POCF

Stakeholders are empowered to make decisions to improve overall program affordability.  
Adapted from POCF

Stakeholders share a high degree of commitment to making the program successful.  
Adapted from POCF

There is a high level of agreement about the ways things are done in the program.  
Generated by research group

Stakeholder comments and recommendations are actively sought regarding system affordability in your program.  
Generated by research group

The processes within your program have never changed.  
Adapted from OCM

Management is interested in deploying efficient processes.  
Adapted from OCM

Management is interested in creating an affordable system.  
Adapted from OCM

Processes can be quickly tailored to meet new conditions and solve problems as they arrive.  
Adapted from OCM

Industry is slow to respond to the needs of your organization.  
Adapted from OCM

Your organization looks for new opportunities to make programs more affordable.  
Adapted from OCM

You have a good understanding of how the program aims to adopt a culture towards affordability.  
Adapted from OCM

Planned development timeline, cost, and performance could be met if work were better organized.  
Adapted from OCM

Program performance is measured on a regular basis.  
Adapted from OCM
People on your program clearly understand what roles and duties are required of them to make the program affordable.  
Adapted from POCF

People on your program understand their impact on the affordability of the program and mission.  
Adapted from POCF

Program leaders always make sure that their subordinates know what is expected of them.  
Adapted from POCF

Your program has long-term purpose and direction.  
Adapted from OCM

There are effective working relationships among stakeholders that allow program milestones to be met.  
Adapted from POCF

Stakeholders are willing to exchange ideas and help each other meet deadlines.  
Adapted from POCF

Stakeholders deliver products on time.  
Generated by research group

Poor scheduling and planning often results in targets not being met.  
Adapted from OCM
Appendix C. Organizational Climate Scale

The Organizational Climate Measure (OCM; Patterson *et al.*, 2005) consists of 17 scales, divided into four quadrants: human relations, internal process, open systems, and rational goal. Items marked with an asterisk (*) are reversed before the scale is calculated. The response scale is: 1 = ‘Definitely false’, 2 = ‘Mostly false’, 3 = ‘Mostly true’, 4 = ‘Definitely true’.

*Autonomy*

Management let people make their own decisions much of the time.

Management trust people to take work-related decisions without getting permission first.

People at the top tightly control the work of those below them. *

Management keep too tight a reign on the way things are done around here. *

It’s important to check things first with the boss before taking a decision. *

*Integration*

People are suspicious of other departments. *

There is very little conflict between departments here.

People in different departments are prepared to share information.

Collaboration between departments is very effective.

There is very little respect between some of the departments here. *

*Involvement*

Management involve people when decisions are made that affect them.

Changes are made without talking to the people involved in them. *

People don’t have any say in decisions which affect their work. *
People feel decisions are frequently made over their heads. *

Information is widely shared 0.695 There are often breakdowns in communication here.

*

**Supervisory Support**

Supervisors here are really good at understanding peoples’ problems.

Supervisors show that they have confidence in those they manage.

Supervisors here are friendly and easy to approach.

Supervisors can be relied upon to give good guidance to people.

Supervisors show an understanding of the people who work for them.

**Training**

People are not properly trained when there is a new machine or bit of equipment. *

People receive enough training when it comes to using new equipment.

The company only gives people the minimum amount of training they need to do their job. *

People are strongly encouraged to develop their skills.

**Welfare**

This company pays little attention to the interests of employees. *

This company tries to look after its employees.

This company cares about its employees.

This company tries to be fair in its actions towards employees.

**Formalization** It is considered extremely important here to follow the rules.

People can ignore formal procedures and rules if it helps get the job done. *

Everything has to be done by the book.
It’s not necessary to follow procedures to the letter around here. *

Nobody gets too upset if people break the rules around here. *

*Tradition*

Senior management like to keep to established, traditional ways of doing things.
The way this organization does things has never changed very much.
Management are not interested in trying out new ideas.
Changes in the way things are done here happen very slowly.

*Innovation & Flexibility*

New ideas are readily accepted here.
This company is quick to respond when changes need to be made.
Management here are quick to spot the need to do things differently.
This organization is very flexible; it can quickly change procedures to meet new conditions and solve problems as they arise.
Assistance in developing new ideas is readily available.
People in this organization are always searching for new ways of looking at problems.

*Outward Focus*

This organization is quite inward looking; it does not concern itself with what is happening in the market place. *

Ways of improving service to the customer are not given much thought. *
Customer needs are not considered top priority here. *
This company is slow to respond to the needs of the customer. *
This organization is continually looking for new opportunities in the market place.

*Reflexivity*
In this organization, the way people work together is readily changed in order to improve performance.

The methods used by this organization to get the job done are often discussed.

There are regular discussions as to whether people in the organization are working effectively together.

In this organization, objectives are modified in light of changing circumstances.

In this organization, time is taken to review organizational objectives.

*Clarity of Organizational Goals*

People have a good understanding of what the organization is trying to do.

The future direction of the company is clearly communicated to everyone.

People aren’t clear about the aims of the company.*

Everyone who works here is well aware of the long-term plans and direction of this company.

There is a strong sense of where the company is going.

*Efficiency Time and money could be saved if work were better organized.*

Things could be done much more efficiently if people stopped to think. *

Poor scheduling and planning often result in targets not being met. *

Productivity could be improved if jobs were organized and planned better. *

*Effort*

People here always want to perform to the best of their ability.

People are enthusiastic about their work.

People here get by with doing as little as possible. *

People are prepared to make a special effort to do a good job.
People here don’t put more effort into their work than they have to. *

*Performance Feedback*

People usually receive feedback on the quality of work they have done.

People don’t have any idea how well they are doing their job. *

In general, it is hard for someone to measure the quality of their performance. *

People’s performance is measured on a regular basis.

The way people do their jobs is rarely assessed. *

*Pressure to Produce*

People are expected to do too much in a day.

In general, peoples’ workloads are not particularly demanding. *

Management require people to work extremely hard.

People here are under pressure to meet targets.

The pace of work here is pretty relaxed. *

*Quality*

This company is always looking to achieve the highest standards of quality.

Quality is taken very seriously here.

People believe the company’s success depends on high-quality work.

This company does not have much of a reputation for top-quality products. *

*Indicates a reverse coded question
Appendix D. Project Organizational Culture Framework

The following is the POCF created by Nguyen and Watanabe (2017): Please choose the most recently completed project on which you were personally involved and provide appropriate answers to the questions/or descriptions below. Based on your experience on the project described, please specify the extent to which you agree that the following conditions and behaviors were present on site. Choose strongly agree only for those conditions that were consciously promoted on this project. Rate from 1 (strongly disagree) to 5 (strongly agree).

A. The project organizational culture.
1. All project participants on this project shared a clear understanding of the objectives and values of the project.
2. The contractors on this project clearly understood what roles and duties were required of them.
3. The client on this project clearly understood what roles and duties were required.
4. All project participants understood each other’s objectives, expectations, and values.
5. When disputes or conflicts occurred, participants first looked to how the project would benefit instead themselves.
6. There were effective working relationships among the participants in exploring innovative solutions and bringing down costs and time.
7. Information was shared, transparent, and available for participants during the course of the project.
8. Project managers provided clear communication, assistance, and support to their subordinates.

9. A high level of mutual trust was shared by the project participants.

10. The participants were not consistently open and respectful to each other.

11. The participants were not really willing to exchange ideas and help each other.

12. Assigning blame and accountability issues were very common when things went wrong.

13. All project participants were viewed as important contributors to the project’s success.

14. Opportunities were provided to develop the capabilities of project participants during the project process.

15. Project participants were empowered to make decisions at any level by themselves.

16. Project participants did not take pride in or celebrate achievements when achieving production milestones.

17. Workers were not given the opportunity to attend any training sessions about skills and safety.

18. Workers were not really respected.

19. Workers were not concerned about health and welfare.

20. The contractors shared a high degree of commitment to making the project successful with regard to quality.

21. The contractors shared a high degree of commitment to making the project successful with regard to schedule.
22. The contractors shared a high degree of commitment to making the project successful with regard to contract costs.

23. The supervisory consultants shared a high degree of commitment to making the project successful.

24. The client shared a high degree of commitment to the contract agreements.

25. Strong leadership was shown by those who were project leaders.

26. Decision-making was liberally encouraged at every level.

27. Leaders always made sure that their subordinates knew what was expected of them.

28. Leaders did not always make sure that individual accountability was clear.

29. Everyone was not given the opportunity to participate in the decision making.

B. Project performance

30. The client was satisfied with the project quality.

31. The client was satisfied with the project schedule.

32. The client was satisfied with the project cost.

33. Safety and environmental conditions in the course of the project were satisfied.

34. How satisfied was the contractor with the level of profitability of this project.

35. Rate the labor productivity.

36. Rate the learning of the participants from the project.
Appendix E. Demographic Questions

What is your age?

What is your gender?
Male (1)
Female (2)
Other (3)

What is your current job title?

What kind of industry do you work in?

How long have you been working in your current field?

What position do you primarily work in?

What size company do you work for?
Small (fewer than 100 employees)
Medium (100 to 999 employees)
Large (1,000+ employees)

What specific disciplines do you work in? (List all that apply)

What is your educational background?

How many years have you worked in your current position?

What stakeholders do you work with? (Examples include: Headquarters, NASA peers, management, industry, etc.)

In which Product Life-Cycle Phases does your work occur? (Please list all that apply)
Appendix F. Budgetary Aspects Analyses

Further statistical analyses were utilized to determine which budgetary aspects of affordability questions were resulting in significant group differences for years at NASA. Additional Kruskal Wallis independent samples tests were conducted for each budgetary aspect question to assess significance levels. A Kruskal-Wallis test was performed on the composite scores of the four groups (0-9 years at NASA, 10-19 years at NASA, 20-29 years at NASA, 30-39 years at NASA). For the question within the Budgetary Aspects affordability group regarding cost overruns, the differences between the rank totals of 115.61 (0-9 years), 72.99 (10-19 years), 74.35 (20-29 years), and 81.55 (30-39 years) were significant, $H(3, n = 169) = 19.58, p = .000$. For the question within the Budgetary Aspects affordability group regarding realistic budgets, the differences between the rank totals of 91.53 (0-9 years), 78.55 (10-19 years), 74.69 (20-29 years), and 90.90 (30-39 years) were non-significant, $H(3, n = 169) = 3.55, p = .314$. For the question within the Budgetary Aspects affordability group regarding staying within the fiscal year budget, the differences between the rank totals of 105.10 (0-9 years), 75.39 (10-19 years), 86.65 (20-29 years), and 80.71 (30-39 years) were significant, $H(3, n = 169) = 8.683, p = .034$. Two out of the three questions indicated significant group differences in ratings: *Your program is likely to experience cost overruns* and *Your program rarely stays within its fiscal year budget*. Results for these additional Kruskal Wallis tests can be seen in Table F.1. Box plots were created as visual representations of median values for both significant questions within the budgetary aspects of affordability grouping of questions and can be seen in Figures F.1 and F.2.
Table F.1 Independent Samples Comparison by Years at NASA per Budgetary Aspects of Affordability Questions. This table depicts the questions within the Budgetary Aspects affordability grouping as well as significance values for each question.

<table>
<thead>
<tr>
<th>Budgetary Aspects of Affordability Question</th>
<th>Kruskal-Wallis $H$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your program budget is likely to experience cost overruns.</td>
<td>19.58</td>
<td>.000</td>
</tr>
<tr>
<td>Your program budget is realistic.</td>
<td>3.55</td>
<td>.314</td>
</tr>
<tr>
<td>Your program rarely stays within its fiscal year budget.</td>
<td>8.68</td>
<td>.034</td>
</tr>
</tbody>
</table>

Figure F.1 Median Rating for Question: “Your program is likely to experience cost overruns.” This figure shows the group differences in ratings between years employed at NASA. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7).

Median values per years at NASA category are as follows: 0-9 years, 4; 10-19 years, 2; 20-29 years, 2; 30-39 years, 2. These results indicate that those who have been employed at NASA MSFC for 0-9 years tend to be neutral and have normally distributed responses when prompted regarding likelihood of cost overruns for their program. A
negative response distribution skew to this question would suggest more respondents do not feel as if cost overruns are likely to occur in their program, as seen in the 10-19, 20-29, and 30-39 year groups. Participants early in their careers may not have as strong of an opinion regarding cost overruns potentially due to lack of knowledge or experience regarding specifics of the program budget. This neutrality may decrease overtime as employees become more aware of how the program typically operates. Those later in their careers may be more familiar with patterns surrounding cost overrun within a program or organization and are therefore more confident that overruns are less likely to occur. Those later in their careers may also have more knowledge regarding the organizational behaviors potentially contributing to cost overruns therefore are more optimistic that these behaviors are not occurring within their program or department.

![Figure F.2 Median Rating for Question: “Your program rarely stays within its fiscal year budget”. This figure shows the group differences in ratings between years employed at NASA. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7).](image)

Median values per years at NASA category are as follows: 0-9 years, 4; 10-19 years, 3; 20-29 years, 4; 30-39 years, 4. These results indicate that those who have
worked at NASA MSFC for 10-19 years have more negatively skewed responses distribution when prompted regarding their program staying within fiscal year budget while all other groups follow a normal distribution of responses. This negative response distribution skew would suggest more respondents in the 10-19 year group believe the program stays within the fiscal year budget as compared to the other groups of years employed at NASA. Those later in their careers with NASA may be more familiar with organizational behaviors potentially impacting whether the organization stays under the fiscal year budget, suggesting less optimistic views.
I believe NASA's top priority is making programs more affordable.

Stakeholders share a high degree of commitment in making your program affordable with regard to costs.

Stakeholders share a high degree of commitment to making the program successful.

Management is interested in creating an affordable system.

You have a good understanding of how the program aims to adopt a culture towards affordability.

Your program has a long-term purpose and direction.

People on your program understand their impact on the affordability of the program and mission.

**Figure G.1** Distribution of NASA Responses for Clarity of Organizational Goals Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Information is shared, transparent, and available for stakeholders in the program you are currently working on.

Project managers provide clear communication, assistance, and support to their subordinates.

There is clear communication from the engineers to the program managers.

There are often breakdowns in communication within your program.

Stakeholder comments and recommendations are actively sought regarding system affordability in your program.

**Figure G.2** Distribution of NASA Responses for Efficiency in Communication Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.

Cooperation and collaboration across positions and departments are actively sought to make your program stay within budget.

Assigning blame and accountability issues are very common when things go wrong.

Stakeholders are willing to exchange ideas and help each other to meet deadlines.

There are effective working relationships among stakeholders that allow program milestones to be met.

**Figure G.3** Distribution of NASA Responses for Effective Working Relationships Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Industry is slow to respond to the needs of NASA.

Planned development timeline, cost, and performance could be met if work were better organized.

Poor scheduling and planning often result in targets not being met.

Stakeholders deliver products on time.

**Figure G.4** Distribution of NASA Responses for Efficiency in Planning and Scheduling Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Most people on your program have input into the decisions that affect the affordability of the program you are currently working on.

When you make decisions impacting affordability, NASA's needs are considered top priority.

When you make decisions impacting affordability, NASA's needs are not considered top priority.

All program stakeholders are viewed as important contributors to your program's success.

Stakeholders are empowered to make decisions to improve overall program affordability.

Program performance is measured on a regular basis.

Program leaders always make sure that their subordinates know what is expected of them.

People on your program clearly understand what roles and duties are required of them to make the program affordable.

**Figure G.5** Distribution of NASA Responses for Clarity of Roles and Responsibilities Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Methods to get the job done more efficiently are often discussed in your program.

There is a high level of agreement about the way things are done in the program.

The processes within your program have never changed.

Management is interested in deploying efficient processes.

Processes can be quickly tailored to meet new conditions and solve problems as they arrive.

Your organization looks for new opportunities to make programs more affordable.

**Figure G.6** Distribution of NASA Responses for Efficiency in Processes Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.

Your program is likely to experience cost over-runs.

Your program budget is realistic.

Your program rarely stays within its fiscal year budget.

**Figure G.7** Distribution of NASA Responses for Budgetary Aspects of Affordability Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
I believe the organization's top priority is making programs more affordable.

Stakeholders share a high degree of commitment in making your program affordable with regard to costs.

Stakeholders share a high degree of commitment to making the program successful.

Management is interested in creating an affordable system.

You have a good understanding of how the program aims to adopt a culture towards affordability.

Your program has a long-term purpose and direction.

People on your program understand their impact on the affordability of the program and mission.

**Figure G.8** Distribution of Student Responses to Clarity of Organizational Goals Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Information is shared, transparent, and available for stakeholders in the program you are currently working on.

Project managers provide clear communication, assistance, and support to their subordinates.

There is clear communication from the engineers to the program managers.

There are often breakdowns in communication within your program.

Stakeholder comments and recommendations are actively sought regarding system affordability in your program.

Figure G.9 Distribution of Student Responses to Efficiency in Communication Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.

Cooperation and collaboration across positions and departments are actively sought to make your program stay within budget.

Assigning blame and accountability issues are very common when things go wrong.

Stakeholders are willing to exchange ideas and help each other to meet deadlines.

There are effective working relationships among stakeholders that allow program milestones to be met.

Figure G.10 Distributions of Student Responses to Effective Working Relationships Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Industry is slow to respond to the needs of your organization.

Planned development timeline, cost, and performance could be met if work were better organized.

Poor scheduling and planning often result in targets not being met.

Stakeholders deliver products on time.

**Figure G.11** Distributions of Student Responses to Efficiency in Planning and Scheduling Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Most people on your program have input into the decisions that affect the affordability of the program you are currently working on.

When you make decisions impacting affordability, the organization's needs are considered top priority.

When you make decisions impacting affordability, the organization's needs are not considered top priority.

All program stakeholders are viewed as important contributors to your program's success.

Stakeholders are empowered to make decisions to improve overall program affordability.

Program performance is measured on a regular basis.

Program leaders always make sure that their subordinates know what is expected of them.

People on your program clearly understand what roles and duties are required of them to make the program affordable.

**Figure G.12** Distribution of Student Responses to Clarity of Roles and Responsibilities Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Methods to get the job done more efficiently are often discussed in your program.

There is a high level of agreement about the way things are done in the program.

The processes within your program have never changed.

Management is interested in deploying efficient processes.

Processes can be quickly tailored to meet new conditions and solve problems as they arrive.

Your organization looks for new opportunities to make programs more affordable.

Figure G.13 Distribution of Student Responses to Efficiency in Processes Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.

Your program is likely to experience cost over-runs.

Your program budget is realistic.

Your program rarely stays within its fiscal year budget.

Figure G.14 Distribution of Student Responses to Budgetary Aspects of Affordability Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
I believe the organization's top priority is making programs more affordable.

Stakeholders share a high degree of commitment in making your program affordable with regard to costs.

Stakeholders share a high degree of commitment to making the program successful.

Management is interested in creating an affordable system.

You have a good understanding of how the program aims to adopt a culture towards affordability.

Your program has a long-term purpose and direction.

People on your program understand their impact on the affordability of the program and mission.

**Figure G.15** Distribution of Industry Responses to Clarity of Organizational Goals Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Information is shared, transparent, and available for stakeholders in the program you are currently working on.

Project managers provide clear communication, assistance, and support to their subordinates.

There is clear communication from the engineers to the program managers.

There are often breakdowns in communication within your program.

Stakeholder comments and recommendations are actively sought regarding system affordability in your program.

Figure G.16 Distribution of Industry Responses of Efficiency in Communication Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.

Cooperation and collaboration across positions and departments are actively sought to make your program stay within budget.

Assigning blame and accountability issues are very common when things go wrong.

Stakeholders are willing to exchange ideas and help each other to meet deadlines.

There are effective working relationships among stakeholders that allow program milestones to be met.

Figure G.17 Distribution of Industry Responses to Effective Working Relationships Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Industry is slow to respond to the needs of your organization.

Planned development timeline, cost, and performance could be met if work were better organized.

Poor scheduling and planning often result in targets not being met.

Stakeholders deliver products on time.

Figure G.18 Distributions of Industry Responses to Efficiency in Planning and Scheduling Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Most people on your program have input into the decisions that affect the affordability of the program you are currently working on.

When you make decisions impacting affordability, the organization's needs are considered top priority.

When you make decisions impacting affordability, the organization's needs are not considered top priority.

All program stakeholders are viewed as important contributors to your program's success.

Stakeholders are empowered to make decisions to improve overall program affordability.

Program performance is measured on a regular basis.

Program leaders always make sure that their subordinates know what is expected of them.

People on your program clearly understand what roles and duties are required of them to make the program affordable.

**Figure G.19** Distributions of Industry Responses to Clarity of Roles and Responsibilities Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.
Methods to get the job done more efficiently are often discussed in your program.

There is a high level of agreement about the way things are done in the program.

The processes within your program have never changed.

Management is interested in deploying efficient processes.

Processes can be quickly tailored to meet new conditions and solve problems as they arrive.

Your organization looks for new opportunities to make programs more affordable.

Your program is likely to experience cost over-runs.

Your program budget is realistic.

Your program rarely stays within its fiscal year budget.

**Figure G.203** Distributions of Industry Responses to Efficiency in Processes Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.

**Figure G.21** Distribution of Industry Responses in Budgetary Aspects of Affordability Questions. Distribution of responses to questions range from Strongly Disagree (1) to Strongly Agree (7). Negative response values such as Strongly Disagree (1), Disagree (2) and Slightly Disagree (3) can be seen in red, neutral response values (4) can be seen in gray, and positive response values such as Slightly Agree (5), Agree (6), and Strongly Agree (7) can be seen in blue.