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Strategies to Reduce Nonconformance of Parts in Aerospace Manufacturing

John Louis Lloyd Jr
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Walden University

College of Management and Technology

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John Louis Lloyd, Jr.

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the review committee have been made.

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Walden University
2022

Abstract

Strategies to Reduce Nonconformance of Parts in Aerospace Manufacturing

by

John Louis Lloyd, Jr.

MBA, Indiana Wesleyan University, 2004

BS, Park University, 1990

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

Walden University

May 2022

Abstract

The cost of nonconformance of parts can impact the aerospace industry globally, resulting in revenue loss and consumer confidence degradation. Grounded in the eight disciplines of problem solving, the purpose of this multiple case study was to explore strategies aerospace manufacturing quality managers in the United States used to implement successful change initiatives to address the nonconformance of parts. Data were collected through semistructured interviews with four aerospace quality executives and supporting company documents. Data were analyzed using methodological triangulation, coding, and thematic analysis. Four themes emerged: (a) identify and implement a specific problem-solving strategy, (b) identify and mitigate employee resistance, (c) identify and exploit collaboration, and (d) identify and leverage leadership commitment. Key recommendations are to develop a culture of quality excellence within the aerospace industry and develop effective problem-solving strategies using the eight disciplines of problem-solving techniques. This action is achieved by identifying the right problem-solving tool, using effective communication to mitigate employee resistance to change, emphasizing solution validation, and ensuring leadership commitment originating from the highest levels of the organization. The implications for social change include the potential to save lives and positively affect society's perceptions of public safety regarding air travel by reducing airline transportation fatalities directly related to the quality failure of aircraft parts.

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Dedication

I would like to dedicate this academic achievement to my mother, Clenisteen Bowie Lloyd (1944-1988), who always encouraged me to write.

Acknowledgments

I want to thank my wife, Diana Cooper Lloyd, whose never-ending support and encouragement always pushed me to be more. Diana's image of me is my beacon of inspiration for the greatest version of me. I would like to also thank my entire doctoral committee for their endless support, guidance, and encouragement throughout this process. To my chair, Dr. Diane Dusick, my second committee member, Dr. Inez Black, and to my URR committee member, Dr. Deborah Nattress, I want you all to know that I appreciate your patience and all that you have done to help me through this academic journey.

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Section 1: Foundation of the Study

Quality control in airline manufacturing affects the lives of passengers and crew who fly throughout the world. Poor parts quality and other factors such as aircraft parts design and fuel quality lead to grounded aircraft or in-service aircraft experiencing engine failure (Adekitan, 2020). The purpose of this study was to explore strategies aerospace manufacturing leaders use to reduce the cost of nonconformance of parts that result in scrap and rework during the manufacturing process.

Background of the Problem

Improving the poor quality of parts by reducing nonconformance and its associated cost is a requirement for leaders who want to compete in the global market and maintain consumer confidence (Wei & Cheng, 2020). Quality improvement requires an organizational change to maintain a competitive advantage and sustainable success in the aerospace manufacturing industry (Haffar et al., 2019). Many variables impact sustainable change regarding strategies to improve the poor quality of parts, such as leadership, the presence of a collaborative culture, or the type of industry (Haffar et al., 2019). What organizational leaders do to manage change directly links to how employees will react to change and whether change management efforts will be successful (de Fátima Nery et al., 2020; Covic & Planinic, 2020).

To achieve sustainable change, leaders must develop a deeper understanding of how their leadership plays a role in implementing change within an organization (Vito & Sethi, 2020). Aerospace manufacturing leaders should also understand global leadership to understand change management and influence through a global context (Tie Suk Kee

et al., 2017). The global context to leadership involves a cross-border effort and multicultural competencies that sync with organizational change, leadership styles, and appropriate problem-solving techniques. Global leadership addresses a large-scale business environment regarding quality improvement and sustainable change management strategies (Tie Suk Kee et al., 2017). When leaders implement sustainable organizational change, they can achieve better aerospace manufacturing quality (Hutton & Eldridge, 2019).

Problem Statement

Quality control and cost management impact the survival of organizations in the aerospace manufacturing industry (Feng et al., 2020, p. 15). Poor parts quality and other factors such as aircraft design and fuel lead to grounded aircraft or in-service aircraft experiencing engine failure (Adekitan, 2020, p. 13). The hidden cost of quality in aerospace parts manufacturing constitutes up to 10% of production costs resulting from rework and scrap (Modhiya & Desai, 2016, p. 88); the global aerospace industry's combined primary elements are worth approximately \$838 billion (Mandolla et al., 2019). The general business problem is that the aerospace manufacturing industry lacks profitability because of the negative impact that nonconformance of parts has on profits. The specific business problem is that aerospace manufacturing leaders lack strategies to reduce the cost of nonconformance of parts that result in scrap and rework during the manufacturing process.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies that successful aerospace manufacturing leaders use to reduce the cost of nonconformance of parts that result in scrap and rework during the manufacturing process. The targeted population consisted of eight business leaders from four different companies responsible for quality control from aerospace manufacturing companies in the United States who have successfully implemented strategies to reduce the cost of nonconforming parts. A total of four participants represented two or more companies each, but only two shared a company where both worked during their careers. The implications for positive social change include the potential to save lives and positively affect society's perception of public safety regarding air travel by reducing airline transportation fatalities directly related to aircraft parts' quality failure. This aspect of social change is particularly important due to the COVID-19 pandemic that has recently dramatically eroded customer confidence in airline travel.

Nature of the Study

I reviewed the qualitative, quantitative, and mixed methods before selecting the qualitative method. Qualitative methodology is rooted in the social constructivist worldview and is often associated with the view that social reality is subjective and co-constructed through human experience (Hamilton & Finley, 2020). Researchers use the quantitative method as an investigative approach of cause and effect as well as variables' correlation through measurement and statistical analysis, including hypothesis testing (Hamilton & Finley, 2020). Quantitative research is associated with numerical data and

statistics to analyze data, and researchers use the mixed-method approach to bridge the gap between qualitative and quantitative research approaches. The mixed-method approach takes advantage of textual data and statistics to explore topics while testing a hypothesis (Moalusi, 2020). Combining qualitative and quantitative research approaches can enhance the breadth of knowledge regarding a topic (Kansteiner & König, 2020). However, the mixed-method approach requires considerable resources and time (Nooraie et al., 2020). I selected the qualitative approach because it allows for real-life observation through interviews or conversations with participants, providing perspective toward problem-solving and the sustainment of organizational change. Additionally, the qualitative approach includes a system of inquiry built on inductive logic, which allows for broad conclusions based on observations, evidence, and patterns that could be useful when applied across a large and global industry such as aerospace manufacturing (Kansteiner & König, 2020).

The three qualitative research designs I considered for my study were (a) phenomenology, (b) narrative, and (c) case study. A phenomenological qualitative research design is interpretive and allows the researcher to focus on the participants' interpretations of lived experiences or a phenomenon (Teti, 2019). The use of a narrative research design allows for rich insight into the experiences of peoples' lives through their personal stories or history making. The narrative approach structures and organizes knowledge from these stories making that information more learnable (Sen, 2020). Neither phenomenology nor the narrative design was appropriate for the study because I sought a descriptive account of strategies used for problem-solving with the aerospace

industry with less emphasis on perception. A single case study would limit the issue of quality to one organization, limiting the discovery of multiple solutions to a problem that may be industry wide. Using a multiple case study allows for a richer view of the phenomena (Yin, 2017). This broader view also allows for an in-depth understanding of the successful implementation of problem-solving strategies for sustained and permanent quality change initiatives used by aerospace manufacturing leaders. Gaining insight from multiple aerospace entities also helped validate my research findings rather than narrow my research to one company.

Research Question

One primary research question guided this study: What strategies do successful aerospace manufacturing industry leaders use to reduce the cost of nonconformance of parts that result in scrap and rework during the manufacturing process?

Interview Questions

1. What have been the costs related to nonconformance of parts that result in scrap and rework during your organization's manufacturing process?
2. What strategies did you use to identify and address the causes of those costs?
3. How did you measure the effectiveness of the strategies?
4. Which strategies were the most effective for reducing the cost of parts' nonconformance?
5. Which strategies were the least effective for reducing the cost of nonconformance?
6. How resistant were your employees to the strategies?

7. How did you address employee resistance?
8. What other information would you like to share regarding reducing the cost of nonconformance of parts that result in scrap and rework during the manufacturing process?

Conceptual Framework

The conceptual framework in this study was the eight disciplines (8Ds) problem-solving technique. The 8Ds methodology was developed in the 1980s by Ford Motor Company to resolve problems and to correct and eliminate recurring problems at the root cause (Realyvásquez-Vargas et al., 2020). The 8Ds method is a model for solving problems requiring an in-depth investigation to determine the root causes and a permanent solution to eliminate them (Realyvásquez-Vargas et al., 2020). This model is widely used in the automotive industry, but other industries, such as aerospace manufacturing, make 8Ds a standard tool across all manufactured commodities. Problem-solving methods like 8Ds provide a significant competitive advantage because they allow faster identification of root causes and for implementing permanent corrective actions (Sharma et al., 2020). The 8Ds method consists of several parts, which could be called 8Ds report steps or stages:

- D1: Team Approach—Establishment of Team.
- D2: Problem Description.
- D3: Development of Interim Corrective Actions to Prevent Damage.
- D4: Definition and Analysis of Root Causes.
- D5: Determination of Permanent Corrective Actions.

- D6: Implementation and Validation of Permanent Corrective Actions.
 - D7: Preventing the Recurrence of Problem.
 - D8: Conclusion of Problem and Appreciation of Team and Individual Merits.
- (Sharma et al., 2020)

This problem-solving tool was appropriate for the study because it directly addresses the cost of poor quality. Previous research indicated that the 8Ds problem-solving method is robust enough to stand alone regarding quality concerns within a business (Realyvásquez-Vargas et al., 2020; Sharma et al., 2020). Using the 8Ds method enabled me to understand the strategies, processes, and tools the participants used to improve the aerospace industry quality processes.

Operational Definitions

Eight disciplines (8Ds) problem-solving technique: A complex tool for solving problems requiring an in-depth investigation to determine the root cause and a permanent solution to eliminate them (Realyvásquez-Vargas et al., 2020)

Organizational change management: Organizational change management is a process in which a group of people within a formal boundary and common purpose agree to a series of actions aimed at taking the organization from one point to another within a time frame (Ik & Adepoju Azeez, 2020).

Quality escapes: Quality escapes are nonconforming parts reaching the customer or end user that final inspection failed to catch (Rusu et al., 2019).

Resistance to change: Resistance to change as a complex multi-faceted phenomenon that is caused by a variety of factors. This resistance is often the result of

employees attempt to protect themselves from any negative consequences they may face as a result to this change which highlights that resistance as what one may feel toward change (Mousa et al., 2020).

Assumptions, Limitations, and Delimitations

Assumptions

Assumptions are elements of research that a researcher assumes to be true without evidence (Verma & Abdel-Salam, 2019). The validity and accuracy of a finding depend on whether the study fulfilled assumptions of data used in the analysis. Thus, none of the assumptions should violate the study (Verma & Abdel-Salam, 2019). First, I assumed participants would have sufficient knowledge to answer the interview questions and be willing to provide sufficient secondary data (e.g., documentation) to support the interview data. I also assumed that participants would be willing to share those documents that support their statements. Third, I assumed that participants were honest and thorough in their responses. Finally, I assumed that the sample composition is appropriate to address the research problem, and the sample size was sufficient to answer the research question.

Limitations

Limitations represent concerns regarding potential weaknesses that are usually out of the researcher's control (Theofanidis & Fountouki, 2018). The results of the study may be limited by my accessibility to executive managers who have quality control experience in aerospace manufacturing. Another limitation is the chosen method of problem-solving of each company with whom the participant is affiliated. The various problem-solving methods could impact a participant's perception of a particular tool's effectiveness,

influencing the data collected. The results of the study are also limited by the honesty and thoroughness of the participants' responses. A lapse of the participants' memory is also a potential weakness or limitation.

Delimitations

Delimitations are limits purposely presented or placed by the researcher to restrict the scope of the study (Adeleke, 2020). The purpose of this qualitative case study was to explore strategies aerospace manufacturing leaders use to address reducing the cost of nonconformance of parts that result in scrap and rework during the manufacturing process. The participants selected for this study only included executive-level quality managers or executive-level operations/production managers with more than 10 years of experience in aerospace companies. These managers or leaders must also impact quality decisions or be responsible for customer complaints regarding quality and nonconformance. This study was delimited to aerospace companies geographically located in the contiguous United States.

Significance of the Study

Quality control and cost management impact the survival of organizations related to aerospace manufacturing (Feng et al., 2020). Poor parts quality leads to grounded aircraft or aircraft in service experiencing engine failure. The latter can cause significant damage to aircraft in flight, resulting in air disasters. Understanding how to prevent and mitigate poor parts quality in aerospace manufacturing could lead to better leadership practices and better implementation of proven quality programs. Successful improvement in quality of aerospace parts could change the airline industry's customer perspective by

increasing trust in air transportation (Oschman, 2019) and bringing renewed economic viability to the air travel and increased competitiveness to the aerospace manufacturing industry.

Contribution to Business Practice

The findings of this study may help businesses in the aerospace manufacturing industry to successfully address the cost of poor parts quality due to nonconformance, which can improve aircraft safety and increase profits. Failure to address aircraft safety could result in poor customer satisfaction, which may affect the competitiveness of the aerospace manufacturing industry (Realyvásquez-Vargas et al., 2020). The study's findings could validate whether the implementation of 8Ds can lower the hidden cost of quality, which constitutes 10% of production cost as a result of rework and scrap (Modhiya & Desai, 2016). Providing aerospace manufacturing managers tools such as 8Ds could catalyze the creation of management strategies to develop permanent solutions to improve key processes to mitigate the costs of nonconformance.

Implications for Social Change

The findings of this study may help businesses in the aerospace manufacturing sector improve aircraft safety. According to the General Aviation Manufacturers Association, in 2017, the general aviation community operated more than 446,000 aircraft flying worldwide with 1,233 accidents in the United States, which was around 5.67 accidents per million flight hours (Huang, 2020). By preventing quality escapes, which are nonconforming parts reaching the customer or end user that final inspection failed to catch, aviation fatalities may drop, thus reducing the loss of life.

A Review of the Professional and Academic Literature

The purpose of this qualitative multiple case study was to explore strategies aerospace manufacturing leaders use to reduce the cost of nonconformance of parts that result in scrap and rework during the manufacturing process. To gather academic and professional literature for this section, I searched ProQuest, Emerald Insight, IEEE Xplore, and SAGE. Table 1 presents a breakdown of the peer-reviewed versus nonpeer-reviewed journals and books used for my academic and literature review, and Table 2 contains all the sources used in the study.

Table 1

Sources in Academic and Professional Literature Review Section

	Total	Total more than 5 years old at graduation date	Percentage of references within 5 years of 2022 graduation (2019-2023)
Peer-reviewed journals	101	11	89%
Books	2	2	0%
Journals that are not peer-reviewed	1	1	0%
Total	104	14	87%

Table 2

Sources in Doctoral Study

	Total	Total more than 5 years old at graduation date	Percentage of references within 5 years of 2022 graduation (2019-2023)
Peer-reviewed journals	161	16	91%
Books	4	2	50%
Journals that are not peer-reviewed	6	1	83%
Total	171	19	89%

The literature review consists of eight main subsections: (a) change management, (b) 8D problem-solving technique, (c) quality management and sustainability, (d) leading organizational change and digitization, (e) authentic leadership, (f) change innovation, implementation, and resistance, (g) collaboration, and (h) aerospace quality. The primary conceptual framework for this study is 8Ds. This model provides a competitive advantage because it allows quality managers and other stakeholders to identify root causes and implement permanent corrective actions for nonconformance issues.

The literature review begins with how organizational change is affected by leadership styles. In the second section, I explore 8Ds. Next, I discuss how quality managers impact the sustainability of new quality initiatives. The fourth subsection reviews the implementation of change and various tools such as technology and digitization. The fifth subsection is a review of specific leadership styles like authentic and transformational leadership that facilitate change management. Next, I discuss how innovation and employee resistance to change can help or hinder the implementation of change due to the 8Ds technique. This is followed by an overview of how teamwork and collaboration are necessary components for successful organizational change efforts. The last subsection of the literature review identifies maintaining high-quality aerospace manufacturing standards and how specific tools such as blockchain and additive manufacturing (AM) help sustain quality improvement efforts.

Change Management

How employees react to organizational change can determine whether the organizational change is successful (Holten et al., 2020). Employees' reactions are

frequently influenced by job design, schedule, and their perceived value of the change (Holten et al., 2020). Leaders who use change management create a vision for the future that utilizes various abilities, techniques, and disciplines through which complexity and specialization translate into actions and results (Herrero et al., 2020). Successful leaders skilled in change management are proactive when addressing the continuous nature of change in organizations (Herrero et al., 2020). Leaders and employees drive organizational change through a process that continuously evolves and is dependent on the organizational leaders' ability to allocate resources to manage that change (Irimiás & Mitev, 2020). Change management also refers to how leaders foster a change culture (Irimiás & Mitev, 2020). However, managing change remains a universal challenge for organizational leaders (Holten et al., 2020).

Effective leaders understand how to motivate employees through a transformational leadership style that many see as inspiring, intellectually stimulating, and considerate of individuals (Benson, 2019). Transformational leadership characteristics are similar to authentic leadership characteristics regarding their humanistic approach to employees (Copeland, 2016; Wong & Walsh, 2020). Authentic and transformational leadership affects how employees positively respond to organizational change (Attah, 2017; Lux, 2019). Leadership, different from management, is based on four parameters: vision establishment, human development, vision execution, and vision outcomes (Holton et al., 2020). Leadership is characterized by developing the vision and setting the direction, communicating the vision and increasing choice, executing the vision through motivation and inspiration, and promoting new products and

approaches as outcomes. By contrast, management is characterized by establishing the vision through planning and process development, organizing and developing policies and procedures, and executing it through controlling, monitoring, and problem-solving, with predictability and expected results (Holten et al., 2020). In this sense, leadership represents a universal approach to organizational changes, emphasizing style.

Conversely, management represents a situational approach to change implementation, emphasizing competencies (Holten et al., 2020). Both change management and change leadership are associated with positive change outcomes, which makes them both required elements to successful change management (Holton et al., 2020).

Change Management Theories

Lewin is considered the father of organizational change (Benson, 2019). Lewin's model suggests three steps for organizational change: unfreezing, moving, and then refreezing. Through this process, the organization is destabilized, allowing the change agents to implement the different processes, and then the change is stabilized, creating a new norm (Benson, 2019). Though Lewin's change theory gained ground in change management for many decades, it has been the target of criticism (Ratana et al., 2020).

The first criticism of Lewin's change model is the simplicity of the process, where organizational change is supposed to be continuous and open-ended. The second criticism of Lewin's change model is that the approach applies only to an incremental and isolated type of change while leaving others irrelevant, regarding them as radical or transformational change instead of correctional and incremental. The third criticism of Lewin's change model is that it deals only with behavioral change (Ratana et al., 2020).

The last and fourth criticism is that the approach is top-down and management-driven and not initiated in the middle of the organization by an engaged employee and competent (Ratana et al., 2020).

Kotter, a Harvard University professor, is also well known as a leader in change management theory. Kotter's most famous work was the eight-step model for creating change (Benson, 2019). The eight steps in his model are

1. Establish a sense of urgency,
2. Form a powerful guiding coalition,
3. Create a vision,
4. Communicate a vision,
5. Empower others to act on a vision,
6. Plan and create short-term wins,
7. Consolidate improvements and produce even more change,
8. Institutionalize new approaches (Benson, 2019).

This model provides organizational change agents with a logical, action-oriented formula for implementing change. The first four steps are to change the organization's status quo, which builds on Lewin's model. Steps 3 through 7 allow the organization to introduce and begin implementing the change. The last step is to permanently change, create a new, or modify the current organizational culture (Benson, 2019). However, this eight-step model for change did not suit my study because it is too broad of an approach for problem-solving in an aerospace precision manufacturing environment.

Theoretical Approach

Theoretical approaches to organizational change continue to evolve (Ratana et al., 2020), particularly when developing sustainable or permanent solutions to organizational problems. Evolutionary change occurs because employees at the middle and lower ranks attempt to innovate and experiment with processes before top management directs a strategic change (Puffer, 2004). Lewin's model represents the planned change approach before the 1990s, which influenced subsequent change models (Ratana et al., 2020). The era of emergent change management began during the 1990s. Emergent theories featured a bottom-up process-driven approach that suggested that change should be expected and mitigated. The emergent theory approach relied on frontline managers' ability to adapt and adopt new process improvement ideas (Ratana et al., 2020). The evolution of organizational change relies on successful change initiatives that are holistic, allowing all organizational members to be initiators of change, such as adopting employee training programs and having internal communication (Chebbi et al., 2020).

The emergent era of organizational change management led to Judson's five-step model that Lewin influenced; the five-phase model was designed for frontline managers to confront change (Ratana et al., 2020). Judson's model consists of five phases: (a) analyzing and planning the change, (b) communicating the change, (c) gaining acceptance of new behaviors, (d) changing from the status quo to the desired state, and (e) consolidating and institutionalizing the new state (Ratana et al., 2020). Analyzing and planning change creates a baseline for change intervention by gathering and analyzing data that supports the need for change (DePorres et al., 2018). Organizational change can

be uncomfortable for all organizational members; however, when change is poorly communicated, the negative effects can be amplified. Thus, it is important for leaders to use communication to address organizational members' uncertainty and ambiguity about the future (Bansal & King, 2020). Trust in the leadership behaviors of management positively correlates to the acceptance of change (Cai et al., 2018). Further, a diffusion of leadership functions positively contributes to successful major change initiatives within organizations, encouraging innovation at all levels to resolve problems through organizational change and complex social and cultural problems (Caulfield & Brenner, 2020).

In the 1990s, similar to Judson's five-phase model, Kanter and Kotter developed change models drawn from Lewin's 3-step model (Ratana et al., 2020). Kanter and Kotter's 10-step model and eight-step model, respectively, are similar. Kanter's 10 steps include (a) analyze the organization and its need for change, (b) create a vision and common direction, (c) separate from the past, (d) create a sense of urgency, (e) support a decisive leadership role, (f) line up political sponsorship, (g) craft an implementation plan, (h) develop enabling structure, (i) communicate, and (j) reinforce and institutionalize the change (Ratana et al., 2020). The eight steps in Kotter's model are (a) establish a sense of urgency, (b) create a guiding coalition, (c) develop vision and strategy, (d) communicate the change vision, (e) empower broad-based action, (f) generate short-term wins, (g) consolidate change, and (h) anchor new approaches in the culture (Caulfield & Brenner, 2020). Changing an organization to a new desired state and institutionalizing that new state is similar to Kanter's idea of institutionalizing change and

Kotter's consolidating and anchoring change within an organization (Caulfield & Brenner, 2020). Kotter advocated that to gain commitment for change, appealing to employee emotion is more important than appealing to facts and logic.

Leadership can tap into employee emotions by communicating a relatable vision, aligning people with the vision, and inspiring them to overcome obstacles to achieve it (Caulfield & Brenner, 2020). This leadership strategy answers the questions "What are some of the motivators for change?" and "What are the barriers?" (Puffer, 2004). Unlike the planned change and emergent approach, the contemporary change management approach involves human, technological, and strategic elements that tend to be bottom-up and middle-manager driven (Ratana et al., 2020). Contemporary change management includes interdependence on open, flexible, practical strategy and IT support (Ratana et al., 2020). Though models like Kanter's and Kotter's offer more detail regarding the implementation steps for initiating and sustaining change within an organization, they do not highlight the critical role played by the different corporate actors during the change process, as does the emergent and contemporary approach to change (Chebbi et al., 2020). In the study, I sought a holistic approach to change that involves the whole organization's participation.

Eight Disciplines Problem-Solving Technique

The 8D problem-solving technique is the conceptual framework selected for this study. The 8Ds is a teamwork-oriented, problem-solving method that focuses on a problem's root cause to solve it through a corrective-action-guided procedure (Realyvásquez-Vargas et al., 2020). Specifically, the 8Ds focus on (D1) develop a team,

(D2) describe the problem, (D3) develop an interim containment action, (D4) determine and verify root causes, (D5) choose/verify permanent corrective actions, (D6) implement and validate corrective actions, (D7) prevent recurrences, and (D8) recognize and congratulate teamwork as well as individual contributions. These principles help create appropriate activities to identify the root causes of a problem and provide permanent solutions to eliminate them (Realyvásquez-Vargas et al., 2020). Though an individual working alone can solve many problems, other problems require a group effort involving people with various skills and knowledge bases (Zarghami & Benbow, 2017). The users of the 8Ds method seek to find the main problems' root causes, identify their possible solutions, and assess their impacts on companies (Realyvásquez-Vargas et al., 2020). The perspective of leaders in business organizations drive the use of 8Ds as well as other techniques such as six sigma, TRIZ (teoriya resheniya izobreatatelskikh zadatch/theory of inventive problem solving), and total quality management (TQM; Realyvásquez-Vargas et al., 2020; Sharma et al., 2020).

The Ford Motor Company is responsible for the original development of the 8Ds method; it was introduced in 1987 to a manual entitled team-oriented problem solving (Realyvásquez-Vargas et al., 2020). Each step in the 8Ds problem-solving process employs skills and methods that contribute to the overall effectiveness of influencing change related to addressing customer complaints and developing solutions for nonconformance of parts (Sharma et al., 2020). Nothing causes anxiety for a team like the release of a corrective action preventive action system and accompanying 8Ds model (Pruitt, 2019).

8Ds, as a tool, is designed to address customer complaints. Addressing customer complaints or holistically customer satisfaction is a requirement for any business that wants to remain globally competitive (Realyvázquez-Vargas et al., 2020). Defects are continuously present in the manufacturing industry and are the leading cause of damages in final products or other components, representing a concerning situation for the industrial and manufacturing sectors (Realyvázquez-Vargas et al., 2020). Regarding the defects, during the manufacturing processes, companies receive material or components from their suppliers. Those materials or components are then changed to create a final product, which must deliver to customers on time and without defects (Realyvázquez-Vargas et al., 2020). In addition to using 8Ds to improve the effectiveness and efficiency of the production process, 8Ds increase product quality, and lower customer complaints. Manufacturing companies rely on other methods and techniques for production improvement, including the six-sigma management philosophy; define, measure, analyze, improve, and control (DMAIC); process flowcharting; and the Deming or Plan, Do, Check, Act cycle (Realyvázquez-Vargas et al., 2020).

The 8Ds method has been used widely in the manufacturing world. The 8Ds method is a tool of the International Organization for Standardization, which it applies broadly in the automotive and aerospace industries for service, including the issues concerning supplier qualification confirmation, process deviations, maintenance, customer complaints, and purchases (Realyvázquez-Vargas et al., 2020). Several authors have also applied the model to solve problems of defects. For example, Mitreva et al. (2015) applied it to solve a problem in an LED diode that does not function in a circuit

board. Similarly, Titu implemented the 8Ds method to reduce complaints about a defective part; consequently, 60 days after implementing corrective actions, no other product was identified with this type of defect, and customers decided to withdraw the complaint (Realyvásquez-Vargas et al., 2020). There are other examples of authors who applied the 8Ds method. Bremmer used 8Ds by analyzing the Scania's global supply chain and determining how the corporation can guarantee the quality of products by applying 8Ds. The result of Bremmer's implementation of 8Ds was successful with improvements due to the expected growth, which is part of the 8Ds validation step (Realyvásquez-Vargas et al., 2020). In the hospitality industry, the 8Ds method can be adopted to solve problems, especially in terms of employee turnover in the housekeeping department. A study by Kumar and Singh addresses the issues regarding the hospitality industry of Delhi and Rajasthan in India. Specifically, the research addresses the issue of employee turnover in the housekeeping department by identifying both causes and solutions with the help of an 8Ds model for problem solving. Finally, Fuli et al. (2016) conducted research that develops a quality improvement procedure for automotive companies based on quality management practices. The 8Ds method and the Six Sigma pilot programs were implemented. Fuli et al.'s work indicated that the proposed procedure is effective among the studied in Chinese and South African automotive industries.

As a conceptual framework for my study, the 8Ds method includes steps with a design that encourages permanent solutions, forcing substantial change in organizational processes. After three decades of being implemented, the 8Ds method is not a fad with

exaggerated and temporary excitement (Zarghami & Benbow, 2017). There is a connection between the 8Ds method and six sigma in that the 8Ds steps and the DMAIC steps used by six sigma practitioners have some parallelism. Through this connection, quality improvement managers accept the 8Ds method as a legitimate lean manufacturing tool (Zarghami & Benbow, 2017).

Quality Management and Sustainability

Quality management and the environmental aspect of sustainability play roles in manufacturing and how processes work together to achieve production goals. The implementation of quality programs involves change, change in process, and perhaps change in organizational culture (Muncut et al., 2019; Pop & ȚiȚu, 2020; Vedenik & Leber, 2015) The initiation of organizational sustainability efforts also relies on organizational change to be successful. The relationship between the two change concepts helps shape an organization and keep that organization competitive (Arda et al., 2019; Chaudhuri & Jayaram, 2019).

Quality management and sustainability contribute to organizational sustainability and the strategic decision-making capability of a firm's leaders to drive competitive advantage (Arda et al., 2019). Quality management practices are prerequisites for implementing environmental management practices that lead to sustainability (Chaudhuri & Jayaram, 2019). Quality management practices have two types of classifications: behavioral quality management practices and technical quality management practices. Behavioral quality focuses on the customer and the business's human resource aspect, meaning it is people-centric. Technical quality focuses on data, information analysis, and

technology-driven efforts (Han & Oh, 2020). Integrated management systems that support technical quality are useful tools for dealing with interdependencies between different systems incorporating objectives, resources, procedures, and strategic goals of a firm, creating a competitive advantage and sustainable organizational development (Arda et al., 2019). The primary aim of any quality management system or lean six sigma is to ensure consistency and reduce or eliminate variation in a sustainable way (Yadav et al., 2020).

Quality Management

Quality management includes quality improvement and control practices, i.e., TQM programs, 8Ds, and six sigma projects (Arda et al., 2019). Organizational leaders can add considerable value to their operations while enhancing the sustainable development of their quality procedures and processes (Arda et al., 2019). The integration of quality management and sustainability will positively affect quality performance, albeit empirical support for this thinking is limited (Chaudhuri & Jayaram, 2019). Chaudhuri and Jayaram (2019) suggested that there are benefits in improved quality and reliability and improved teamwork through the combined effect of quality management and sustainability management. Quality management and environmental management are integrated and jointly implemented management systems (Arda et al., 2019). While successful integration of quality and sustainability partially depends on the availability of resources, it is also contingent on top management's commitment to consider integration a strategic tool to gain competitive advantage (Arda et al., 2019).

Sustainability

Sustainability can improve business performance and environmental and social performance by cutting waste and reducing pollution (Chaudhuri & Jayaram, 2019). However, some organizational leaders feel there are problems related to integrating sustainability processes, including rising costs, differences between quality and environmental cultures, and problems associated with internal conflict among corporate leaders (Arda et al., 2019). Other organizational leaders regard practicing green, is a *voluntary mandate*. Supporting a green environment is linked to pollution-free, environmental protection, and sustainable development (Huilong & Dan, 2020). From a global economic context, environmental governance and sustainable development are gradually becoming a necessary priority concern for all countries (Huilong & Dan, 2020). The most widely recognized definition of sustainability comes from the Brundtland Commission's report of 1987 (Warde, 2011). This definition indicates the value of stakeholders and the environment, such as future generations and natural resources, and that organizations must behave ethically, valuing their development to meet the needs of the present generation without compromising the ability of future generations to meet their own needs (Abbas, 2020; Warde, 2011). Globally, leaders of corporations should be concerned with accelerating industrialization, rapid population growth, widespread malnutrition, depletion of nonrenewable resources, and a deteriorating environment (Meadows et al., 1972). If this phenomenon continues, a sudden and uncontrollable decline in both population and industrial capacity should be expected (Meadows et al.,

1972). Taking a different approach to sustainability could alter the growth trends mentioned above, according to Meadows et al. (1972).

The aim of corporate sustainability is to achieve environmental, social, and economic sustainability and link them to decision-making processes and programs (Abbas, 2020) using tools such as 8Ds, TQM, and International Organization for Standardization standards. Together, these concepts improve organizational performance through quality and sustainability (Abbas, 2020). These standards, in particular, are one of the most successful management system standards globally (Yadav et al., 2020), though their success relies on the state's regulatory efforts. Negative attitudes regarding climate change can stifle voluntary actions of organizational leaders toward corporate sustainability (Richter & Medunic, 2020). The push for corporate sustainability forces the emergence of leaders who create readiness and enforce corporate sustainability (Thakhathi et al., 2019).

There are several tools and strategies available to sustainability leaders that can help enforce corporate sustainability. Information and communication technologies are tools that can improve emission reduction, waste management, and production cleanliness. These technologies can also enhance the implementation of green development strategies to benefit the firms' ecosystem (Irimiás & Mitev, 2020). Regarding organizational change and corporate sustainability strategies, Thakhathi et al. (2019) discussed seven influencing strategies in their study that support change: (a) active participation, (b) persuasive communication, (c) management of internal/external information, (d) human resource management practices, (e) diffusion practices, (f) rites

and ceremonies, and (g) formalization activities. Leaders use these seven strategies to create a readiness for corporate sustainability.

Active participation, as an influencing strategy, solidifies the organizational leader's commitment to organizational change through personal experiences (Thakhathi et al., 2019). The efforts of corporate leaders to effect change require active involvement. Persuasive communication is a strategy used to elicit a commitment to change. Selling the change message is a practice that can be implemented to affect this influencing strategy through various mediums (Thakhathi et al., 2019). Regarding policy failure, Richter and Medunic (2020) purported that there is an implementation trap caused by an existing gap between theory and implementation. Richter and Medunic (2020) suggested that organizations might lack resources regarding communication, creating a vague understanding among stakeholders of the policy goal leading to organizational change.

During organizational change efforts, policy failure may be due to the policies not being specific enough, communication shortfalls, and the lack of participation from leaders, increasing conflict. (Richter & Medunic, 2020). Management of internal/external communication influences strategies for encouraging organizational member commitment and reinforcing the change message (Thakhathi et al., 2019). Managers must consider the processing and controlling information as part of the change management process and be actively involved in that process (Rohmah & Subriadi, 2020). A leader's ability to convey and manage information directly impacts how far organizational change can be successfully implemented (Rohmah & Subriadi, 2020). The implementation of information technology (IT) and technology relating to information systems can change

an organization's communication processes. Leaders' support of these process changes may also affect an organization's existing applications, systems, and structures used for communication (Rohmah & Subriadi, 2020).

Human Resources

Human resource management practices involve the organization's human element, which is an essential element for organizational change (Thakhathi et al., 2019). It is also transformative and supports innovation through training and knowledge recruitment (Tian et al, 2019). Organizational leaders seek to spread organizational change progressively from small to larger subunits of the organization through diffusion practices (Thakhathi et al., 2019). To be successful, the message of change must reach everyone. Another influencing strategy for organizational change is rites and ceremonies. Leaders use informal sharing of innovative ideas regarding sustainability in knowledge sharing sessions, which, according to Thakhathi et al. (2019), represent rites and ceremonies, respectively. Finally, sustainability leaders use formalization activities to formalize the change by altering the tasks, activities, processes, systems, and even the organization's structure at large (Thakhathi et al., 2019). Thakhathi et al. (2019) confirmed that sustainability leaders serve as active collaborators by selling change messages both within and outside the organization (Thakhathi et al., 2019). Corporate sustainability and change are a global issue, and one cannot exist without the other.

Leading Organizational Change and Digitization

Organizational change and digitization are technological tools that can advance communication and problem-solving strategies within an organization and help to sustain

that change. The use of technology can impact the entire organization, shifting or creating a new organizational culture and structure of a production system (Herrero et al., 2020). Digitization can help the sustainment of organizational change. Irimiás and Mitev (2020) suggested there is a relationship between digital maturity, change management, and business performance. Irimiás and Mitev (2020) hypothesized that a digitalization led sustainability transition of business practices based on green development, similar to quality improvement, can lead to modified sustainable organizational goals. However, digitization can be a challenge regarding production processes in the aerospace industry due to quality requirements associated with reliability and safety (Pfirrmann et al., 2019).

Organizational Change

New technology can impact organizational change, which is represented by a new industrial revolution. Disruptive technological advances drive the new industrial revolution or Industry 4.0, such as cyber-physical systems, internet of things, cloud computing, big data, cybersecurity, autonomous robots, and augmented reality, simulation, machine-to-machine technologies, and artificial intelligence (Herrero et al., 2020). These technologies allow data sharing between the different machines and agents, which, in turn, support a continuous improvement process that allows for a more flexible, automated, and optimized production flow (Herrero et al., 2020). In addition to the use of technology to support organizational change, sustainability control tools integrate sustainability issues in corporate strategies and decision-making (Ligonie, 2021). According to case studies in German manufacturing companies, digital consistency is a top priority in the effective implementation of Industry 4.0 (Herrero et al., 2020). Digital

technology within manufacturing supports enterprise resource planning information systems (Herrero et al., 2020). Both consulting firms and enterprise resource planning solution providers agree that several factors are necessary for the successful implementation of such a technological solution inside a company: the presence of a steering committee (leadership), the reengineering of business processes (management), training the new users in the new systems and processes (human resource management), and change management (everyone; Herrero et al., 2020).

Digitalization

There is a relationship between change management and digitalization that require a better understanding of corporate leaders' perceptions of change (Irimiás & Mitev, 2020). Change management and sustainability are global concepts where the interconnectedness of industries is supported by digitization, even though business processes and activities are still concentrated locally (Irimiás & Mitev, 2020). Digitalization, as a tool, supports sustainable environmental, social, and economic development, according to Irimiás and Mitev (2020). Irimiás and Mitev (2020) argued that digitalization could be perceived as either a threat or an opportunity. Just as there are organizational change leaders, sustainability leaders take on the role of creating a readiness agenda for change regarding corporate sustainability (Thakhathi et al., 2019). Continuous improvement requires firms to develop new competencies and use resources and capabilities to reach a competitive advantage (Irimiás & Mitev, 2020). A firm with strong capabilities and commitment can develop proactive strategies that benefit the firm

and its environment, supporting organizational change and sustainability (Irimiás & Mitev, 2020).

Historically, automotive and aerospace companies focused on mass production and precision manufacturing; both are heavily dependent on quality (Herrero et al., 2020). Flexible manufacturing systems improve these manufacturing facilities' flexibility by connecting them via computer networks and allowing them to respond rapidly to changes in customer requirements and complaints (Herrero et al., 2020). These systems have increased the complexity, and industry 4.0 shapes the new manufacturing environment by improving productivity and quality (Herrero et al., 2020). While the automotive and aerospace industries are already highly successful and competitive, the benefits of environmental sustainability strategies are debated, focusing on environmental sustainability as a threat to competitiveness. However, corporate sustainability can ensure a long-term competitive advantage (Richter & Medunic, 2020). Leaders of organizations can no longer operate without considering the interconnectedness between society, their environment, and their economic aspirations (Thakhathi et al., 2019).

Authentic Leadership

Authentic leadership is a process that draws from both positive psychological capacities and a highly developed organizational context, which results in greater self-awareness and self-regulated positive behaviors on the part of leaders and associates, fostering positive self-development (Yavuz, 2020). The effectiveness of a leadership style, such as authentic leadership, influences organizational change by setting objectives that support change. Authentic leadership emerged from the idea that leaders should

possess ethical value for long-term efficiency and success within organizations (Yavuz, 2020). Authentic leadership includes transparency, sharing of information, accepting responsibility, and avoiding deceptive practices (Bakari et al., 2017), which increases the effectiveness of a leader.

Self-Awareness

Authentic leadership has the following four components: self-awareness, internalized moral perspective, relational transparency, and balanced processing (Wong & Walsh, 2020). Authentic leaders achieve the first component, self-awareness, through self-reflection and seeking feedback from their peers or subordinates (Wong & Walsh, 2020). Tomkins and Nicholds (2017) submitted that authentic leaders are self-aware and self-regulating change managers who are grounded by a committed sense of self-reflecting on their convictions. Copeland (2016) combines two authentic leader leadership traits, authenticity and self-awareness, and suggested that they match the characteristic traits of authentic leadership and ethical authentic transformational leadership. Wong and Walsh (2020) posited that self-awareness refers not only to leaders possessing a thorough recognition of their strengths, weaknesses and values, but also involves obtaining and maintaining an accurate understanding of how they influence and are perceived by others. Authentic leaders accept and acknowledge their thoughts, emotions, needs, preferences, or beliefs while seeking to develop a better understanding of oneself (Copeland, 2016; Wong & Walsh, 2020).

Internalized Moral Perspective

Authentic leaders practice moral fortitude, the second characteristic of authentic leadership, by resisting pressure to deviate from doing what is right. Wong and Walsh (2020) referred to the act of doing the right thing as an internalized moral perspective. Authentic leaders' purposeful intent connects to ethical behavior, which encapsulates meaningful behavior and moral values. Authentic leaders provide direction (Attah et al., 2017) that is free from moral degradation and moral conflict. Copeland (2016) described authentic leaders the same way as Wong and Walsh (2020) and Tomkins and Nicholds (2017). Attah et al. (2017) and Copeland combined definition encompasses Wong and Walsh's idea of a moral compass and communication transparency, and Tomkins and Nicholds' concept of personal moral convictions. Copeland also specifically addressed ethical and transformational leadership to illustrate how other leadership styles support and complement authentic leadership.

Components of ethical and transformational leadership align with Wong and Walsh's conception of a moral perspective. Copeland (2016), Bakari et al. (2017), Tomkins and Nicholds (2017), Wong and Walsh (2020), and Yazuz (2020) are similar in that they framed authentic leadership around self-awareness, internalized moral perspective, relational transparency, and balanced processing. Ethics, as it relates to moral perspective, is a pivotal dimension to authentic leadership, its implication is present through authentic leadership morality, relational transparency, and values. Wong and Walsh (2020) focused on ethics in the same way Yavuz (2020) did in their study. They explored how transformational and authentic leadership influence organizational

behavior, organizational development, and, ultimately, organizational performance.

Ethics, or the moral perspective, includes truthfulness and truthful communication which is transparency. These ethical attributes build trust that authentic leadership can leverage to positively influence employees who will ultimately sustain corporate values and culture (Lux, 2019); this is similar to the idea of moral perspective described by Wong and Walsh (2020) and Attah et al. (2017).

Relational Transparency

Relational transparency, the third authentic leadership component, represents open and honest communication, which fosters trust (Copeland, 2016). Kempster et al. (2019) defined relational transparency as valuing and achieving openness and truthfulness in close relationships with followers. This definition of relational transparency also includes the free exchange of knowledge and information. Ethical leaders demonstrate proactive concern for their followers and peers' ethical behavior as a centerpiece of their behavior, aligning to the idea of relational transparency (Copeland, 2016). Transformational leaders, whom Copeland sees as authentic leaders, encourage employees to produce more, stretching their capabilities beyond their personal perceived limits. Kempster et al.'s perspective on relational transparency, though similar to Copeland, differs by connecting relational transparency to emotions regarding authentic leadership. Kempster et al. sought to connect the idea of authentic leaders' notion of *true-self* to emotional authenticity as a relational transparency phenomenon.

Al-Ghanem et al. (2020) attempted to bridge leadership theory and organizational change theory to examine leadership networks through social network theory.

Organizational transformation initiatives or organizational change depend on leaders driving change with various types of effective leadership styles. The notion of transparency, factual reporting, fostering trust, and sustained organizational change are components of authentic leadership that will help leaders navigate new leadership standards created by COVID-19 (Bakari et al., 2017; Wong & Walsh, 2020; Yavuz, 2020). Fleming and Millar (2019) suggested that the new expectation is that leaders must operate in what they refer to as a new normal, representing change, both externally and within organizations. A new normal can be achieved through a form of balance processing that includes active listening of diverse opinions that support innovative decision making (Wong & Walsh, 2020). Globally, societies are experiencing a change in politics, racial inequality, and healthcare. At times, this adaptation to change occurs in the absence of complete data (Coffey et al., 2020). The coronavirus (COVID-19) has prompted the most rapid and radical social and cultural changes in decades (Roth et al., 2020). The COVID-19 pandemic challenged all organizational leaders to respond rapidly to healthcare, education, and manufacturing (Weiss & Li, 2020). To execute this guidance, effective authentic leadership is helpful. Leaders implementing successful organizational change rely on their leader's impact or influence (Al-Ghanem et al., 2020).

Balanced Processing

Through an open-minded form of listening or balanced processing, the final authentic leadership component, transformational leaders encourage their followers to look beyond their interests and consider the organization's best interests (Copeland, 2016). Combining the concepts of authenticity, transformational thinking, and ethics into

a flexible leadership style dramatically improves the success rate of implementing organizational change. Authentic leadership is useful to help organizations and employees cope with new societal conditions. The environment, domestically and globally, is changing rapidly, and organizational leaders must adapt.

Balanced processing involves decision making, whereby authentic leaders solicit and listen to diverse opinions. Implementing change within an organization is regularly regarded as a difficult task for most business leaders, often resulting in failed initiatives. Bakari et al. (2017) purported that these failures result from a lack of leadership efficiency and integrity. To be effective as a leader *and follower*, one must be open to change (Attah et al., 2017), and be self-aware. Authentic leaders lead with purpose, meaning, and values, which are part of a well-developed vision, which are characteristics typical of transformational leaders (Yavuz, 2020). Additionally, authentic leadership contributes to sustained and successful change within an organization (Yavuz, 2020).

Attah et al. (2017) suggested that authentic leadership is a leadership style most appropriate for the successful implementation of organizational change. The type of leadership style matters especially considering the many leadership failures of U.S. business leaders in the early 21st century, which gave way to scrutinizing the theories of authentic and ethical leadership (Copeland, 2016). Copeland (2016) concluded that leaders are more effective when practicing authentic or ethical leadership and demonstrating transformational behaviors than those who do not. One of Copeland's (2016) hypotheses was that there is a positive relationship between the levels of authentic, ethical, and transformational leadership behaviors and leader effectiveness.

The results of Copeland's study indicated that there was a positive relationship between the levels of authentic, ethical, and transformational leadership and leader effectiveness. Copeland's research provided evidence that authentic, ethical, and transformational leaders are more effective, and that each of these behaviors can improve the positive outcomes of a leader. These traits, which Copeland (2016) highlights in the discussion on authenticity, transformational thinking, and ethics, serve to build trust between managers and followers in the decision-making process by encouraging their voice during the change activity (Bakari et al., 2017). Moreover, Bakari et al. (2017) recognized that authentic leadership stems from Henderson and Hoy's 1983 work on authenticity and inauthenticity of leaders. Authentic leaders tend to support organizational change and contribute to a higher likelihood of sustaining that change within the organization (Bakari et al., 2017). Both Yavuz (2020) and Bakari et al. (2017) noted that authentic leaders support the sustainment of organizational change, but Yavuz (2020) focused more on self-development as a leader.

Attah et al. (2017) and Lux (2019) shifted the focus of authentic leaders to the organization. Authentic leaders can affect how employees positively respond to change, but authentic leadership also impacts the organization and the formulation of an organizational culture. Since employees often see organizational change through their perception of what is happening around them (Bakari et al., 2017), the leadership style leading that change matters. Authentic leaders' influence goes beyond the leader-follower dynamic to affect followers' experiences within organizations (Lux, 2019). While the leadership styles influence and shape organizations, the employees whose affective

commitment to their organization is the missing relational link between the employee and organizational outcome (Attah, 2017). In other words, leadership style and the organizational culture it creates, both determine organizational outcomes. Highly effective, authentic leadership supports successful change implementation within an organization and minimizing resistance to change.

Change, Implementation, and Resistance

The goal of organizational change in the context of this study is to reduce the occurrence of nonconformance of aerospace parts through innovative problem-solving methods that are sustainable. Innovation, leadership, and managing employee resistance are required for the successful sustainment of organizational change. Leaders have a role in shaping organizational change and can be a source of creative ideas that recognize future opportunities and threats (Kozioł-Nadolna, 2020). Leaders must be willing to take on a broader role that requires them to support innovation, significantly change through innovation processes (Kozioł-Nadolna, 2020). Innovation represents a new or improved product or process and, at times, a combination of both (Kozioł-Nadolna, 2020). Most studies focus on one type of innovation. However, Sciarelli et al. (2020) contended that organizations should focus on implementing both production and process innovation to maximize innovation's successful outcome.

Change Implementation

Rate and Scale. The rate of change and scale of occurrence characterize change implementation (Samal & Chatterjee, 2020). Change implementation can be incrementally continuous or holistic. Incremental change occurs in individual parts and at

any level of an organization addressing problems separately as they occur (Samal & Chatterjee, 2020). Regarding change implementation rate specifically, incrementally finite change is associated with departmental and functional changes, whereas incrementally continuous change is related to organizational-wide changes (Samal & Chatterjee, 2020). The scale of change refers to the degree of change required to reach a specific and desired outcome (Samal & Chatterjee, 2020).

Similarly, large scale change is a holistic modification to problematic or innovative processes and behavior across organizational systems to obtain a meaningful level of the desired output. For change to be successful, strong leadership is needed to manage all stakeholders' collaboration, which could be multicultural (Samal & Chatterjee, 2020). Many organizations operate on a global stage, so multicultural teams have become more commonplace, representing unique challenges for organizational leaders (Tie Suk Kee et al., 2020).

Implementation. Change implementation has many approaches to how change occurs within an organization. Change that can be planned and emergent appears to dominate the current state of literature in the organizational change context (Samal & Chatterjee, 2020). For implementing large scale changes, Samal and Chatterjee (2020) suggested that a holistic strategy be used and aligned into four different categories: fine-tuning, incremental adjustment, modular transformation, and corporate transformation. Fine-tuning or convergent change refers to on-going organizational change that aims to assimilate an organization's strategy with its people, processes, and structure (Samal & Chatterjee, 2020). Large scale organizational change generally helps develop managers at

all levels of the organization, resulting in increased volume, reduced cost, and improved quality (Samal & Chatterjee, 2020). Rate of change, the scale of change, change implementation, and resistance to change are concepts associated with the organizational change process. Processes such as TQM and 8D of problem-solving are often impacted by several of these concepts. Change is an omnipresent element in any organization whose leaders operate at both operational and strategic levels. Thus, most researchers understand that organizational change and organizational strategy go hand in hand; this thinking is flawed (Samal & Chatterjee, 2020). Organizational change is often reactionary, making strategy development difficult because of a lack of a planning phase. The need for change can be unpredictable and can take the form characterized by reactivity and discontinuity, pushing a firm into a state of prolonged crisis (Samal & Chatterjee, 2020).

Resistance to Change

Just as organizational change can result from many factors, resistance to organizational change has several contributing reasons. This complicated relationship between change and resistance is one reason for the estimation that somewhere between 40% and 70% of change initiatives fail (Peus et al., 2009). Leadership style and communication add to this complexity. Organizational learning as a version of organizational change forces an evolution of the cultural foundation of the organization. The modification of assumptions and values of an organization create a new problem-solving approach (Mousa et al., 2019). Organizational learning related to organizational

change connects to changes in processes and the resistance to the change in those processes (Schulz-Knappe et al., 2019).

Employee resistance to change is a negative response to organizational change, but the reason for that resistance can vary widely (Pereira et al., 2019). Mousa et al. (2019) defined resistance to change as the employees' desire to maintain the status quo. However, most definitions for resistance to change focus only on the opposition or employees' unfavorable reactions towards change (Mousa et al., 2019). Employees' resistance to change is not always negative, in that, sometimes an employee's resistance may help leaders manage organizational change. Resistance may guide managers in redirecting the planned strategy for change by halting change that may not be in the organization's best interests (Mousa et al., 2019).

There are three levels of resistance to change: (a) organization-level resistance, (b) group-level resistance, and (c) individual-level resistance (Mousa et al., 2019). The organization-level resistance is the expected changes in power, functional structure, and organizational culture. The second is group-level resistance, which results from a change in group norms, routines, and groupthink. The third is individual-level resistance and often comes from an individual's fears of uncertainty, injustice, locus of control, and losing a job (Mousa et al., 2019). An adaptable leadership style is needed to manage these resistance areas, particularly individual resistance (Mousa et al., 2019). Similar to the perspectives of Bakari et al. (2017) and Yavuz (2020), Mousa et al. (2019) purported that authentic leaders are more capable, in comparison to other styles of leadership such as transformational leaders, to control and eliminate the risk of resistance change from

individual employees (Mousa et al., 2019). The main difference between authentic and transformational leadership is that authentic leaders focus on developing followers' psychological and practical capabilities. In contrast, transformational leaders often intend to develop their followers into leaders (Mousa et al., 2019).

Individual Level. There is a relationship between authentic leadership and individual-level resistance, and there is a connection between individual-level resistance and organizational commitment (Mousa et al., 2019). Organizational leaders and scholars who analyze the relationship of authentic leadership with organizational commitment (a) investigate the relationship of authentic leadership with work engagement, (b) explore the relationship of authentic leadership with organizational citizenship behavior, and (c) agree that authentic leadership is the appropriate response for employee resistance to change (Mousa et al., 2019). Resistance to change is also affected by an individual's trust in management or the change agents implementing the change (Schulz-Knappe et al., 2019). Schulz-Knappe et al. (2019) suggested a correlation between the level of trust in management and its competence regarding employee response to the change processes.

Business process management is an approach for continuous assessment, analysis, and performance improvement of processes, impacting corporate success through customer and shareholder satisfaction (Pereira et al., 2019). Ensuring employees are part of business process management can affect how organizational change influences workers' resistance to change by creating a bridge (Veloso-Besio et al., 2019). Implementation of this management considers the effects of individuals' acceptance of change regarding the change leader's hierarchical position and trust in management as

reasons for resistance to change caused by implementation (Pereira et al., 2019).

Generally, the communication of change, the level of understanding of change, the consistency of the management involvement with the change, and allowing employee participation in the change process influence individuals' attitudes and resistances toward change (Schulz-Knappe et al., 2019).

Group Level Change. Trust should be a priority between top managers and employees. Top-level managers and organizational leaders should build trust among their employees to facilitate and sustain effective organizational change (Sabra et al., 2019). Building trust is an acknowledgement of authentic leadership in that authentic leaders continually develop and disseminate hope, resilience, confidence, optimism, and ethics, which strengthen trust (Mousa et al., 2019). Employee resistance is often the result of employees attempting to protect themselves from any adverse consequences they may face due to organizational change, which can be exacerbated by the lack of trust in managerial change agents (Mousa et al., 2019). To avoid or minimize resistance to change, managers should try to understand the factors influencing employees' reluctance and hesitation to accept organizational changes (Pereira et al., 2019).

How employees feel about the idea of change and how they feel about the managers who represent the change are two primary factors that influence individual's attitude against organizational change (Schulz-Knappe et al., 2019). This employee perspective suggests that the supervisor-employee relationship affects the employees' resistance to change (Schulz-Knappe et al., 2019). Additionally, national culture, in-organization norms, leaders' mindset, and stakeholders' pressure influence the process of

organizational change (Mousa et al., 2019); thus, it is worth noting that authentic leadership has influence mostly in Western developed economies (Mousa et al., 2019). These economies are where the need for increasing demands for ethics, integrity, and the demand for a more adaptive and value-based leadership style (Mousa et al., 2019). Organization leaders should not underestimate the importance of the employee-organization relationship, including communication, which facilitates employees' cooperation in change situations (Schulz-Knappe et al., 2019).

Organizational Level Change. Organizational change can be implemented top-down or bottom-up. The former means that the general management initiates and communicates the organizational change, while the latter depends on the employees to be the key drivers of change (Schulz-Knappe et al., 2019). Organizational change can be complex, large-scale, and highly technical, or change can be simple, but both can result in new work routines or an adaptation of the organizational mission (Schulz-Knappe et al., 2019). The differences in employees' attitudes or personal characteristics may influence whether they support or resist the anticipated organizational change (Schulz-Knappe et al., 2019); this indicates that a person's attitude towards change motivates them to act in one way instead of another (Mousa et al., 2019). Schulz-Knappe et al. (2019) suggested that change communication can mitigate employee resistance within the organizations' complex hierarchies. Schulz-Knappe et al. also purport that employees' informational and emotional needs during change require a successful change communication strategy. According to Mousa et al. (2019), employees resist change because they are not a part of the planning for the change process, where poor communication is the driver for

employee's resistance to change (Mousa et al., 2019). Sabra et al. (2019) concluded that successful organizational change depends on managers' communicative and informative skills at all levels.

Aerospace Manufacturing Collaboration and Teamwork

Aerospace manufacturing requires collaboration and teamwork both domestically and globally. Collaboration and teamwork address efforts in engineering, environmental concerns, and quality improvement for example. The 8D problem-solving technique is a teamwork-oriented problem-solving technique that also requires collaboration and teamwork. This collaborative effort involves leadership, open communication, and openness to sustainable change within an organization, which supports innovation and solutions for quality problems and customer complaints. Regarding aerospace manufacturing, innovation, in particular, contributes to competitiveness and problem-solving because innovation leads to new markets, new sources of supply, and new organizational structures (Zahoor & Al-Tabbaa, 2020). There has long since been a global expansion within aerospace manufacturing, auto manufacturing, and other industries. In the international business environment, companies are expanding geographically. This globalization by organizational leaders creates a multicultural workgroup, or team, comprised of diverse members from different national backgrounds and cultures working together on a common purpose. This type of multicultural collaboration is fast becoming the norm within many organizations (Cole et al., 2019).

Collaboration

Working towards a common goal is the foundational idea of team-based collaboration, which requires that team members work together and communicate effectively (Cole et al., 2019). Collaboration allows for possibilities that are not obtainable using individual effort; that is, collaboration involves sharing risks, resources, and responsibilities to achieve a common goal (Cole et al., 2019). Research on the effects of collaboration and effectiveness in face-to-face and virtual teams identifies inclusion, integration and compromise, and open communication as important collaboration characteristics (Cole et al., 2019). Collaboration among team members is an essential factor in team effectiveness, supporting effective innovative and creative team outcomes (Cole et al., 2019). Additionally, Grijalvo and Sanz-Samalea (2020) asserted that customer satisfaction and cooperation with suppliers promote collaborative relationships where the team can use external knowledge, leading to process innovation, process improvement, and solutions to quality problems.

Aerospace Manufacturing Teamwork

Leaders in the automotive industry have a primary focus on safety, while the aerospace industry leaders focus on quality and the development of quality management systems. Because aerospace products are subject to strict requirements regarding quality and reliability, manufacturers must emphasize quality (Grijalvo & Sanz-Samalea, 2020). However, Industry 4.0 improves productivity and working conditions by advancing manufacturing systems and new technology, teamwork and collaboration remain a necessary element for maintaining a competitive advantage (Pérez et al., 2020).

The SOAR framework used by some industries is team-oriented, collaborative, and inclusive. Leaders who use the SOAR framework seek to involve all individuals having a perspective and stake in the organization's strategic planning initiatives regarding quality and other regulated standards (Cole et al., 2019). SOAR is an acronym for strengths, opportunities, aspirations, and results (Cole et al., 2019). SOAR begins with an inquiry into what works well, followed by identifying possible opportunities for growth or possible sustainable solutions (Cole et al., 2019). Through strategic investigation with an appreciative intent, SOAR supports teams and team members, the collaborative process of dialogue, and strengths-based information exchange; the type of information exchange that happens when using the 8Ds technique (Cole et al., 2019).

Aerospace Manufacturing Quality

According to 2018 data, the aircraft industry was worth around \$300 billion, but the global aerospace industry's combined primary elements were worth approximately \$838 billion (Mandolla et al., 2019). The 2019 data found in the Aerospace Industries Associations (2019) publication are slightly higher, indicating a positive industry growth. This positive growth is dependent on sustainable high quality within aerospace manufacturing. Sustainable quality of products is why aerospace manufacturing leaders support traceability of aircraft components for quality improvement by digitizing that industry (Pfirrmann et al., 2019). Quality standards work with other tools such as AM, network collaboration, and blockchain to ensure competitive superiority. Moreover, to ensure high quality and safety standards, the highly technological aircraft industry is governed by restrictive technical standards (Mandolla et al., 2019). Leaders use

technological tools to measure and track the cost of quality to improve parts quality and monitor the overall performance of an aerospace manufacturing organization (Alglawe et al., 2019). Measuring the cost of quality via expenditures, such as prevention cost, serves as a good indicator of positive industry growth. Prevention costs represent all activities that occur to reduce or prevent poor quality in aerospace manufacturing of parts (Alglawe et al., 2019).

The process of making a three-dimensional object based on layer-by-layer or drop-by-drop deposition of materials under a computer-controlled system is AM technology (Kim et al., 2018). Blockchain is a distributed ledger or shared database that provides a way for information to be recorded and shared by a community. Blockchain provides decentralized trust, data security and integrity, traceability, transparency, visibility, and auditability across various aerospace and defense industries, which can enhance industry level quality improvement (Ahmad et al., 2021; Wasim Ahmad et al., 2021). Due to strict aerospace manufacturing standards, design changes such as those that take place with AM for parts must be recorded, tracked, and communicated. Thus, blockchain and AM are strictly related since blockchain assist in assuring compliance with AM rules (Mandolla et al., 2019; Wasim Ahmad et al., 2021).

Design Quality

Design quality is directly related to engineering design efforts and the integration of that knowledge through collaborative efforts with other manufacturing teams, who work to improve manufacturing quality by reducing defects (Souri et al., 2019). Aerospace manufacturing firms operate in a network of firms that need to collaborate to

design and produce a product or a service while innovatively incorporating quality management systems (Luomaranta & Martinsuo, 2019). Enhanced collaboration, improved processes, and improved quality of the products or services, greater customer satisfaction, and an increased profit margin are the goals of a company's existence through the use of a quality management system (Tomic & Spasojevic Brkic, 2019). Aerospace technology manufacturers apply modern approaches to ensure high-quality results throughout the entire product life cycle. Implementation and development of the quality management system in the design and manufacture of aerospace parts and AM technology are key areas that ensure aerospace parts' quality integrity (Dmitriev et al., 2020). All of these measures, tools, and other manufacturing activities come together to reduce disruptions, quality failures, defects, and scrappage rework (Souri et al., 2019). The aerospace industry, which is highly specialized and safety-critical, relies on engineered systems that require a vast resource of knowledge sharing and expertise accessibility throughout all product lifecycle stages (Souri et al., 2019). Design quality and various technologies enable collaborative knowledge capture between the internal design teams and manufacturing engineering teams (Souri et al., 2019).

Blockchain

Blockchain is an emerging technology that establishes trust to facilitate cooperation and collaboration among aerospace manufacturing organizations, but the concept remains unfamiliar to many corporate leaders in the aerospace manufacturing industry (Wasim Ahmad et al., 2021). Blockchain emerged within the financial services industry, initially in concert with the cryptocurrency, bitcoin (Mandolla et al., 2019).

Blockchain is a process to distribute data among stakeholders and allows for data security and integrity, traceability, and transparency (Wasim Ahmad et al., 2021). Also, blockchain allows changes to a design to happen instantly to facilitate the AM process's efficiency (Mandolla et al., 2019). Blockchain mitigates risks regarding a breach of data through unauthorized access. Finally, blockchain provides an append-only modification of historical data and is censorship-resistant. These features help with cyber risk and Intellectual Property (IP) protection, intended to provide an indelible and traceable record of changes (Mandolla et al., 2019).

Additive Manufacturing

AM generally refers to AM production processes originating from digital models instead of traditional techniques such as machining by chip removal, cutting, and drilling (Mandolla et al., 2019). Additionally, AM technology requires the use of various materials, such as ceramic, steel, alloy, composites, and living tissue, compared with traditional manufacturing (Kim et al., 2018). The three-dimensional CAD model that initiates the AM process divides software integration into the machine control system or online services (Mandolla et al., 2019). However, AM technology has advanced and increased in popularity within the aerospace manufacturing industry due to advances in the production of metal powders for three-dimensional printing (Dmitriev et al., 2020). According to Kim et al. (2018), AM industries have proliferated quickly since 2000 and have shown almost six times more growth during the 2000s than the growth during the 1990s. In many cases, manufacturing elements such as quality, product development, and waste or cost reduction were catalyst for the advancement of AM technology

(Luomaranta & Martinsuo, 2019). The application of AM three-dimensional design systems and engineering analysis makes it possible not only to produce products that meet quality requirements but also significantly reduce costs at the development and design stages (Dmitriev et al., 2020).

Blockchain supports AM, which impacts aerospace manufacturing supply chains (Mandolla et al. (2019). AM technology and quality improvement collaborate in the same manner as AM technology collaborates with blockchain. AM technology allows for precise changes in aviation part design, while blockchain tracks and records those changes to support parts' quality improvement (Mandolla et al., 2019). Additive manufacturing enables the manufacturability of highly complex parts in a way that saves production costs and ensures production sustainability (Oyesola et al., 2018).

Summary

In this literature review, I explored 8Ds as a conceptual framework to highlight the sustainability of new quality strategies by quality managers within the aerospace manufacturing industry. I purported that leadership styles can play a substantial role in the management of an organization. I illustrated those factors that influence a leader's ability to implement strategies and sustainment efforts that support organizational change. Thus, organizational change supports the reduction of nonconforming parts in aerospace manufacturing. I highlighted how technology can impact quality initiatives and collaboration for quality design throughout the lifecycle of aircraft components. Digitization, an analysis of authentic leadership, innovation, and collaboration, can

influence change management related to quality management sustainability, including employee resistance to organizational change.

The 8Ds model provides a competitive advantage because it allows quality managers and other stakeholders to explore, with depth, the root causes for nonconformance issues within the aerospace industry. After understanding the root cause for nonconformance, the implementation of change becomes a critical component to achieving sustainable change. To achieve sustainable change, I think that quality change leadership is necessary, where specific leadership styles like authentic and transformational leadership can help facilitate. Finally, tools such as blockchain and AM represent the innovation that supports sustainable strategic solutions for improvement efforts within aerospace manufacturing

Transition

In Section 1 of this study, I presented the background of the problem, the problem statement, the purpose of studying change in the aerospace manufacturing sector, the research question for the study, the interview questions for the study, the significance of the study, and its social impact, the qualitative nature of the study, and a review of professional academic literature related to the research problem.

In Section 2 of this study, I present the description of the project, including the role of the researcher, participants, the research method, the research design, population and sampling, ethical research, data collection instruments, data collection technique, data organization techniques, data analysis, and the reliability and validity. In Section 3, I will present the findings of the study, the application to professional practice, the

implications for social change, recommendations for action, recommendations for further research, a reflection on my experience within the DBA doctoral study process, and a conclusion of the study.

Section 2: The Project

The previous section included the background of the problem, the problem statement, the purpose of studying change in the aerospace manufacturing sector, and a review of professional academic literature related to the research problem. Section 2 begins with the purpose of the study and the role of the researcher as well as information on participants. I then present the research method, the research design, population and sampling, ethical research, data collection instruments, data collection technique, data organization techniques, and data analysis. Section 2 concludes with a discussion of the reliability and validity of the study.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies that successful aerospace manufacturing leaders use to reduce the cost of nonconformance of parts that result in scrap and rework during the manufacturing process. The targeted population consisted of eight business leaders from four different companies responsible for quality control from aerospace manufacturing companies in the United States who have successfully implemented strategies to reduce the cost of nonconforming parts. A total of four participants represented two or more companies each, but only two shared a company where both worked during their careers. The implications for positive social change include the potential to save lives and positively affect society's perception of public safety regarding air travel by reducing airline transportation fatalities directly related to aircraft parts' quality failure. This aspect of social change is particularly

important due to the COVID-19 pandemic that recently has dramatically eroded customer confidence in airline travel.

Role of the Researcher

Qualitative researchers use tools, techniques, and protocols, and ethically guide participants; the qualitative researcher is the primary instrument in qualitative research. I was the primary research instrument for this study by conducting semistructured interviews and requesting company documents. I encouraged participants to construct their meaning of reality from their experiences of interacting with the phenomenon without bias (Ananth & Maistry, 2020). I trusted participants with data generation, analysis, and interpretation in a facilitative way to prevent power relations and bias issues during this qualitative research study (Ananth & Maistry, 2020).

I was transparent, honest and professional with my study participants about my experience with the topic and research. I have spent more than 10 years in the aerospace manufacturing industry, both commercial and defense. Change management is also something that I am familiar with within the private sector and the military or public sector. My experience with change management was successful in almost all scenarios in which I played a role. In my effort to be fair, I presented all sides of a debate, issues, or responses even if I disagreed with some of the opinions (Dragga & Voss, 2020). Professionalism in research includes the process of reviewing, critiquing, and providing comments on research results before deciding to publish them (Dragga & Voss, 2020). I did not include anyone in my study with whom I had a prior working or platonic relationship.

As a researcher, I conducted an ethical study that aligns with the *Belmont Report*. To address the human rights of subjects during research, the *Belmont Report* conceived unifying ethical principles: (a) respect for persons, in that they are treated as autonomous agents or given protection if their autonomy is diminished, (b) beneficence or do no harm, and (c) justice as it relates to the benefits of research and the equitable distribution thereof (U.S. National Commission for the Protection of Human Subjects of Biomedical, & Behavioral Research, 1978). Before I began my research, I received approval from the Walden University Institutional Review Board (IRB).

Using an interview protocol (see Appendix), I investigated complex constructs, such as beliefs and identity, which can help build quality and consistency into the research (Braaten et al., 2020). Data collection should have a well-developed interview protocol for qualitative research (Braaten et al., 2020). A semistructured interview protocol guides the interview in several areas: (a) heading, (b) instructions for the interview participant, (c) the research question, (d) interview questions, and (e) probing questions. I used the protocol to sequentially explore thoughts and feelings related to a quality manager executive's role and their strategy for quality improvement (see Caperton et al., 2020). Semistructured interviews are part of qualitative research protocols where complex social constructs such as beliefs and identities where my study will investigate in parallel (Braaten et al., 2020). The semistructured interview offered additional depth to the interview questions by inviting dialogic exchange. I engaged in purposeful questioning and discussion with participants, facilitating a re-telling of strategic events that successfully address poor quality. This exchange allowed me to

actively build knowledge in partnership with the participant who is constructing answers to my questions, requiring them to consider issues in more depth. I analyzed the responses through the lens of the 8D problem-solving technique for quality improvement strategy and the theory of change management.

Researchers should do all they can to mitigate bias in research studies because biases may unduly influence the data analysis (Caperton et al., 2020). Before conducting interviews, I discussed my expectations and biases regarding my study's focus (Caperton et al., 2020). Any biases highlighted were discussed and monitored throughout my study. I remained vigilant regarding the dangers of stereotyping traditional leadership styles or gender, for example (Caperton et al., 2020). Using an interview guide also helped keep both the interview and the participant focused and facilitate a more in-depth response from research participants, as I am a novice researcher. At the initiation of the interviews, I included a few minutes of general welcome and introduction to help put the research participants at ease. Participants received a detailed and personal orientation to the interview process. I exhibited interest in what the participants shared, conveyed that there are no expectations as far as how to answer the interview questions, showed respect for their role as an expert, and made sure that the interview feels natural rather than interrogated (see Roberts, 2020).

Participants

A deliberate focus was put on participant selection because it is challenging to study or observe a phenomenon between people in various locations and at various times without quality participants (Rook, 2018). Rook (2018) suggested a three-step process for

finding participants: (a) administering peer-reporting questionnaires, (b) conducting social network analysis, and (c) triangulating data through observations and interviews. My participants were chosen based on industry and years of experience. The participants should have 10 years of experience as an executive-level quality manager or executive-level operations/production manager in an aerospace manufacturing company. I also sought participants who were actively involved in successful change initiatives within the last 6 years.

I used purposeful sampling to identify participants who have the experience of the phenomenon I plan to discuss in my study (Kahraman & Çelik, 2020). Criterion sampling allowed selection from a group of participants who meet a series of criteria specified by the researcher (Yılar, 2020). Primarily, I used my LinkedIn network to contact prospective participants via email. My LinkedIn network consists of more than 500 connections, and most of those connections are affiliated with the aerospace industry. Establishing a relationship with prospective participants will also allow for making new contacts through them or snowballing. I reached out to 30 of my LinkedIn connections who met or exceeded the requirements to participate. I explained my academic efforts to them and asked if they would consider volunteering for my study as a participant. Out of 30 requests, I planned for 8–10 possible participants. I hoped that my own experience in the aerospace industry would put prospective participants at ease, though this could have had a reverse effect if the company is a competitor.

Research Method and Design

Research Method

I reviewed the qualitative, quantitative, and mixed methods before selecting the qualitative method. Qualitative researchers use rich textual data rather than numerical data to identify and interpret themes relevant to the research problem (Moalusi, 2020). Qualitative researchers use logic that does not test theory, producing findings that are not from statistical procedures or other quantification methods (Pratt et al., 2020). Nonnumerical or textual data, content or narrative analysis, coding, and themes can come from aerospace quality executives' interviews as part of the qualitative method. Quantitative research is associated with numerical data and statistics to analyze data, and researchers use the mixed-method approach to bridge the gap between qualitative and quantitative research approaches. The mixed-method approach takes advantage of textual data and statistics to explore topics while testing a hypothesis (Moalusi, 2020).

The qualitative method helped me understand strategies to reduce the nonconformance of parts within the aerospace manufacturing industry through actual experiences and discussions. The quantitative method was not appropriate to address the research problem because it would not allow for such an in-depth understanding of the topic by focusing on numerical data rather than participants' perspectives. Additionally, the quantitative method does not allow for a discussion about the relationship between methods and ethics since quantitative researchers often claim their methods are value-neutral and are already objective. I did not choose a mixed-method for my study for the same reasons; the qualitative method is appropriate for my study.

Research Design

The three qualitative research designs I considered for my study were (a) phenomenology, (b) narrative, and (c) case study. A phenomenological design is structured compared to the narrative and case study design (Creswell et al., 2007). Now called *descriptive phenomenology*, this study design is one of the most commonly used methodologies in qualitative research, particularly in the social and health sciences (Deakin, 2020). Researchers use the design to describe how human beings experience a particular phenomenon (Deakin, 2020). In addition, the researchers use the phenomenological design to understand the lived experiences of persons about a phenomenon (Creswell et al., 2007). When researchers use this design, they primarily collect data through interviews, although documents, observations, and art may also be considered (Creswell et al., 2007). I did not choose a phenomenological design for my study because it is primarily suitable for documenting the phenomenon as lived experiences and tends to require a more rigid approach to data analysis.

By contrast, the narrative design has little structure. Narrative design data collection allows participants to describe their experiences, which, in turn, allows researchers to discern meaning from reflective essays, for example (Waheed et al., 2021). Data analysis tends to be chronological using elements of a story (Creswell et al., 2007). Narrative research analysis reflects how participants tell a story and the generation of the dialog; thus, the researcher analyzes data collected from the perspective of the participant rather than a specific phenomenon (Yamamoto, 2021). I did not choose a narrative design for my study because a narrative design is suitable for exploring the life and history of an

individual and focuses on the interpretation of stories rather than the phenomenon being studied (Pathirange et al., 2020).

The case study design features narratives with a structure that reflects the complexities, contradictions, and other real-life nuances (Çakar & Aykol, 2021). Qualitative methods can also include action research to explore change in real-world environments and solve a specific problem in a specific context (Hager et al., 2021); therefore, a qualitative method would be appropriate for exploring strategies for improving the aerospace manufacturing industry. A researcher can achieve this kind of exploration using journal keeping, document collection, and case studies (Hager et al., 2021). A case study is a qualitative form of research design. It is also considered a comparative study, a retrospective study, a snapshot (e.g., analysis of state and process at the time of the research), or a longitudinal study (Çakar & Aykol, 2021).

In a case study, researchers use multiple data sources to develop a contextual understanding of the phenomenon to confront theory by comparing it with empirical data (Çakar & Aykol, 2021). However, a case study's data cannot be generalized to the broader population, where a specific sample of the population will allow focus on the trustworthiness of the data. Trustworthiness embodies four main principles: credibility, transferability, dependability, and confirmability, through which the legitimacy of case studies can be established (Çakar & Aykol, 2021). When researchers want to ask *what* and *how* questions about a set of events or phenomena they cannot control as investigators, they use a case study design. The case study design allows for in-depth

study of organizations in various settings and the exploration of the role of organizational culture in the study (Pathirange et al., 2020).

A case study research design involves three basic approaches: explanatory, exploratory, and descriptive (Pathirange et al., 2020). My approach for my case study research design was exploratory, which was suitable to explore situations and processes in a case, and it is appropriate to answer *what*, *how*, and *why* questions in the research, particularly issues in a business organization (Pathirange et al., 2020). I did not use the explanatory case study approach because it typically explains causal relationships and develops theories through a detailed explanation of the phenomenon (Pathirange et al., 2020). I did not use the descriptive case study approach because it is primarily for cause-and-effect analysis (Pathirange et al., 2020). To support my findings' credibility and review data saturation, I conducted member checking with the participants (Bleyel et al., 2020). Using member checking allowed me to confirm that the participants' personal views expressed in the interviews are accurate in the results' final consolidation (Bleyel et al., 2020). Member checking is a useful way to ensure the data is correct and that participants agree with the information I will ultimately present in my study (Newton-Levinson et al., 2020).

Population and Sampling

I used criterion sampling for my study to achieve data saturation, which is a form of purposeful sampling. Criterion sampling allows selection from a group of participants who meet a series of criteria specified by the researcher (Yilar, 2020). In my study, the criteria for the participants will be business leaders from different companies who are

responsible for quality control from aerospace manufacturing companies in the United States and have successfully implemented strategies to reduce the cost of nonconforming parts.

Purposeful sampling also allows the researcher to choose participants based on their expertise in the field; however, biases may occur in the participants' and the researchers' interpretations (Gabarre & Gabarre, 2020). This sampling strategy provides a solution for time constraints, constraints of resources, and limited access to information and expertise (Benoot et al., 2016). The targeted group that criterion sampling creates focuses on the participants' location, experiences, perspectives, and actions. This focus should address my study's central features that include aerospace executive experiences with quality management and strategic solutions (Bungay et al., 2016). Using a biased sample of participants could limit my conclusions. However, a purposeful sample is necessary to answer the research question concerning experiences for lack of strategy for quality improvement aerospace manufacturing and possibly problematic leadership (Brooker & Cumming, 2019).

Exhaustive sampling is an approach that is time-consuming due to the yield of extensive data sets that are impractical to screen (Benoot et al., 2016). Other methods used in sampling are maximum variation, convenience, and mixed (Araşkal & Kılınc, 2019). The maximum variation technique would encourage selecting participants from different industries and different companies (Araşkal & Kılınc, 2019). Maximum variation is an effective sampling strategy for validity and reliability, but it would be time-consuming. Convenience sampling involves selecting cases that are easy to access

and inexpensive to study. This type of sampling is neither purposeful nor strategic (Benoot et al., 2016). Mixed sampling combines two or more sampling strategies to select evidence that adequately addresses strategic purpose. While this sampling strategy does facilitate triangulation, it also produces evidence that is less rigid, thus capable of meeting the needs of multiple research studies (Benoot et al., 2016). For my study, I will interview executive level managers with at least 10 years of experience. In addition to this, I would like to conduct the interview off-site to protect the identity of my participant. However, I think it would be valuable to have the opportunity to visit the facility, allowing the participant to use the physical location to clarify or illustrate concepts and ideas thoroughly. I could present on-site as a visitor requesting a tour or as a prospective new hire.

Guest et al. (2020) described data saturation as a conceptual yardstick for estimating and assessing qualitative sample sizes. For purposes of this study, data saturation will be achieved when the data collected are sufficient to cover the themes of interest and that collecting further data will not bring new relevant information (Fofana et al., 2020). In a broader sense, saturation is the point in data collection and analysis when new incoming data produce little or no new information to address the research question (Guest et al., 2020). Defining data saturation this way moves the focus, to some degree, away from the number of participants to the number of themes. I will begin with 8 participants and add more if I fail to reach data saturation for my study.

Ethical Research

Ethical practices towards participants, individuals, and organizations are an element of any research study. The COVID-19 pandemic made ethical consideration more challenging. COVID-19 was identified in late December 2019 following an outbreak in China (Calia et al., 2021). This outbreak prompted a response from the World Health Organization, which declared the outbreak a pandemic. By the end of June 2020, the virus had reached six continents, approaching 10,000,000 infections and 500,000 deaths (Calia et al., 2021). New measures, including new protocols for research, were required to decrease the speed of spread, prevent contagion and decrease mortality (Calia et al., 2021). Nevertheless, this list of consideration has five criteria: (a) informed consent, (b) withdrawal from a study, (c) participant incentives, (d) ethical protection of participants, and (e) safety procedures for data maintenance now includes safety protocols to keep participants safe. Researchers are also at risk of becoming ill or dying (Calia et al., 2021).

During my study, I followed the Belmont Report, which consists of (a) to protect the person's anonymity, (b) the researcher must be truthful, (c) voluntary participation, and (d) beneficence and justice (U.S. National Commission for the Protection of Human Subjects of Biomedical, & Behavioral Research, 1978). I will obtain informed consent (see Appendix B) via email from each participant and explain the steps to withdraw from the study. At any point in the study, the participant can request release from the study with any repercussions. This request for release can be done by email, phone, text, messenger applications, or in person. There is no plan to offer any incentives to the

participants. My initial plan is to conduct the interviews using video conferencing based on social distancing requirements dictated by COVID-19.

I will not use any names for individuals or organizations; I plan to use pseudonyms and a coding system. Tentatively, each participant will be coded as P plus a numeral. Organizations will have a pseudonym and documents will be coded with the first letter of the pseudonym and a numeral. For example, participants will be coded as P1O1, P1O2, P2O1, etc. All data from my research will be locked in a security box which only I will have access to. As a requirement of Walden University, I will store all of the data securely for 5 years. I will obtain Walden University's IRB approval number before beginning any data collection activity. My Walden University IRB approval number is 11-02-21-1009088.

Ethical accountability starts before the project begins by considering the research culture of our institutions and their ability to support ethical practice and data collection, with priority to accountability to our participants and organizations (Calia et al., 2021). A significant element of informed consent stipulated by guidelines is that it needs to be a voluntary decision. Therefore, the design of the consent processes should consider the participants' and industry's needs to highlight the value gained from the process and study (Scicluna et al., 2019). There should also be guidelines that warn against dependent relationships between researchers and participants, as this may erode a participant's voluntary consent (Xu et al., 2020). This conflict of interest is an important point since I interviewed participants in an industry that I have worked in for 15 years. Research ethics committees and IRBs have a significant role in this process (Ballantyne et al., 2020).

Data Collection Instruments

In this study, I will address one research question: what strategies do aerospace manufacturing industry leaders use to reduce the cost of nonconformance of parts that result in scrap and rework during the manufacturing process? To help answer this question, I was the primary data collection instrument and used semistructured interviews, member checking, and relevant documents. Semistructured interviews allow for the flexible collection of qualitative data. This flexibility allows the interviewees to better explain or build on their responses (Ramírez et al., 2019). I would have liked to conduct all interviews face-to-face; however, this was not possible due to post-pandemic protocols, even though there has been gradual ease on social contact restrictions as of June 2021. Face-to-face interviews reduce the time delay between question and answer and allow the interviewee more spontaneity. Establishing interview protocols that represent what I will do and what I will say will assist in controlling any bias I may have during the interview process (see Appendix A).

Conversely, telephone interviews allow for extended reflection (Opdenakker, 2006). Interviewees seem to be more forthcoming during a face-to-face interview (Burton, 2018). However, the anonymity of the telephone makes it easier for interviewees to disclose sensitive information, according to a study by Burton (2018). Burton's (2018) study also suggested that telephone and face-to-face interviewees considered face-to-face contact results in stronger emotional connections between interviewer and interviewees, which lead to stronger mutual trust. Social cues are essential in an interview, particularly when the interview shifts focus away from the topic (Opdenakker, 2006); social cues are

not possible over the telephone. I do not desire to use other interview techniques such as computer messaging or video conferencing because of the same disadvantages of telephone interviews.

I used member checking to validate and enhance credibility. Member checking represents one of two methods, along with peer review, to achieve credibility (Munson & Ensign, 2021). Member checking can ensure the credibility and applicability of results (Jensen et al., 2021). Mailing or emailing all participants a summary of the interview results and asking about the current relevance and emergence of concerns would assist in validating my findings (Jensen et al., 2021). Participants will discuss and verify the main topics and themes and clarify misinformation (Abel et al., 2021). The member checking effort could be further enhanced through synthesized member checking. Synthesized member checking goes beyond a summary. Synthesized member checking involves sending each participant the interview transcript and short descriptions of the identified themes. The process asks participants to address the accuracy of the transcript and theme and comment on any questions or concerns they had (Munson & Ensign, 2021).

Data Collection Technique

I plan to conduct an expert review using semistructured interviews, member checking, and document analysis. Semistructured interviews allow for a flexible but structured method of obtaining a rich data set for analysis (Peesker et al., 2019). The semistructured interview method allows for the analysis of the main problem of the research topic in-depth (Ulutaş, 2021). As shown in the interview protocol (Appendix A), the research questions should create broad themes that will enable me to understand

individual interpretations of the research topic (Peesker et al., 2019). Qualitative semistructured interviews also allow for depth in data and social cues (Gruber et al., 2021). I will not be using a pilot study to explore the feasibility of my qualitative research due to time constraints (de López et al., 2021). To address trust and cooperation, I will be member checking synthesized answers after negotiating timing, dissemination, and format with the participant (Naidu & Prose, 2018). By member checking interview answers, participants will discuss and verify the main topics and clarify misinformation (Abel et al., 2021).

I used documentary research to assist in collecting statistical data and dealing with any possible legal or regulatory aspects of the subject (Ulutaş, 2021). According to Ulutaş (2021), documents are essential sources of information that can be useful in qualitative research to facilitate researchers to obtain data separate from observations and interviews. More specifically, policy document analysis, which is a method for investigating the nature of policies guiding an organization providing some understanding of the nature and purpose of the policy (Cardno, 2018). Cardno (2018) suggested that the rationale for document analysis lies in its role in methodological and data triangulation, the immense value of documents in case study research, and its usefulness as a stand-alone method for specialized forms of qualitative research (Cardno, 2018). There are some shortfalls to using documentary research for evidence in a study, such as a retrieval impediment, deliberately blocked access, confidential disclosures, geographical location, and that the production of documents is not explicitly for research purposes (Cardno, 2018).

Data Organization Technique

I used several tools or systems such as research logs or diaries, reflective journals, cataloging, secured storage, or coding systems to organize research data for my study. Learning logs and diaries will provide a personal descriptive narrative, and reflective journals assist in creating an analytical perspective for the data I collected (Hojeij et al., 2021). My research questions will help guide me in using reflective journals to conduct thematic content analysis to reveal themes and sub-themes (Ahmed, 2019). The data from my study was triangulated through reflective journals, diaries, interviews, and company documents similar to Chua and Soon (2021) in their study for teaching in Mandarin via mobile learning. Qualitative research is a cyclical, non-linear process where coding is not just naming themes but connecting themes back to the data and the data back to the themes through triangulation (Parameswaran et al., 2020). Data storage is also a concern.

Data management involves good data stewardship, which includes consideration for data sharing and repurposing (Antonio et al., 2020). Data storage for qualitative research should also address concepts of trustworthiness and credibility (Antonio et al., 2020). The other element of data storage involves anonymity. Data collected anonymously will differ from data that is collected nonanonymously. For example, Audette et al. (2020) suggested that participants provide different answers to the same interview research questions, depending on whether the participants know that the interview is anonymous versus nonanonymous, anonymous data reduces the likelihood of confirmatory bias, which strengthens a study's validity (Audette et al., 2020). Therefore, my electronic data storage plan will involve a private password-protected mobile drive

stored in a combination safe to which only I will have access. In addition, I plan to store all physical research data in the same combination safe. My data plan will remain in place for 5 years to protect the confidentiality of my study participants.

To further protect the names of individuals and organizations, I used pseudonyms. Using codes and labels should help me to keep data organized. Researchers can achieve coding with text and non-text data, including transcripts of interviews and journals (Parameswaran et al., 2020). The coding for documents such as informed consent forms and company documents will follow the same process. Also, qualitative research often requires interpretation within the qualitative framework of data collected (Parameswaran et al., 2020). Thus, I used a computer-assisted qualitative data analysis software, NVivo, to generate themes and coding transcripts (Craig et al., 2021).

Data Analysis

Qualitative case study research can involve four types of triangulations: data source, methods, the use of hypotheses or theory, and researcher or investigator triangulation, the most popular being methodological triangulation (Musa & Isha, 2021). Data source triangulation in qualitative case study research uses qualitative data from sources, such as interviews from different participants, at different times, or observation of divergent situations or contexts (Farquhar et al., 2020). Triangulation of qualitative methods and analyses of different data sources can help answer research questions (Petruzzi et al., 2021). Investigator triangulation involves multiple investigators collecting and analyzing data (Bates & Ludwig, 2020). The viewpoint of each investigator represents a particular stakeholder perspective within a given research

domain, a viewpoint from which to observe phenomena during the conduct of a research study (Clarke & Davison, 2020). Theoretical triangulation provides a higher level of insight by looking at a data set from several theoretical perspectives and is a critical test for competing theories (Farquhar et al., 2020). Methodological triangulation uses more than one method to gather data, such as documents and semistructured interviews (Fischer & Van de Bovenkamp, 2019). I will use methodological triangulation to determine results using two or more consistent explanations with the cross-validation between different methods. This type of triangulation should ensure high reliability, transferability, and credibility for my study (Liang et al., 2021).

I followed three primary steps to conduct my data analysis, which (a) analyzing and coding the interview transcripts, (b) using NVivo software to organize data, and (c) analyzing company documents if possible. I plan to use predetermined codes and a qualitative codebook for my study that will facilitate the data coding phase organizing the data and associated analysis (Petruzzi et al., 2021). The interview transcripts will be analyzed and coded for patterns or themes. I tried to associate patterns or themes to new studies published since the conception of my study. I processed the data I collected using a qualitative data analysis tool to analyze interviews, audio files, spreadsheets, videos, and literature (Babčanová et al., 2021). In order to achieve robustness and depth of insight, the principle of triangulation needs to be applied not only to data sources and research methods but also to researcher perspectives (Clarke & Davison, 2020). Also, to achieve data consistency and authenticity and reduce bias and increase data credibility, I plan to use member checks and peer reviews (Bates & Ludwig, 2020).

Reliability and Validity

Reliability

Reliability and validity were developed traditionally as criteria for the scientific verification of empirical research in the human sciences. However, reliability and validity have origins back to the structural test invented by Cronbach, known as Cronbach's alpha. Cronbach's alpha is a measure of internal consistency representing how closely related a set of items are as a group. This measure is a measure of scale reliability (Huttunen & Kakkori, 2020). Cronbach's Alpha coefficient is a method for some research studies to report scale reliability of questionnaires. Nevertheless, using the test results to estimate a lower bound for the scale reliability (Schrepp, 2020). Different from quantitative research, reliability for qualitative research focuses on consistency (Kardes, 2020).

Qualitative research emerged in the 1960s, and it became apparent that the traditional utility of validity and reliability was not applicable (Huttunen & Kakkori, 2020). However, both reliability and validity represent trustworthiness. Trustworthiness is the main validation criterion comprised of four dimensions (a) credibility, (b) transferability, (c) dependability, and (d) confirmability (Huttunen & Kakkori, 2020). Specifically, trying to achieve the dependability of research data addresses reliability. Dependability in qualitative research refers to data stability over time and conditions (Ellis, 2019). Analyst triangulation can enhance dependability by analyzing data by more than one person independently of each other where the biases of any researcher become less critical in the overall interpretation of the study (Ellis, 2019). This type of

triangulation, along with dependability, addresses whether the process of collecting the qualitative data was sound (Haven & Van Grootel, 2019). To achieve reliability and dependability, I will utilize an independent review of my research data by peers or experts in the field of study.

Validity

Credibility, transferability, and confirmability as validation criteria use internal validity, external validity, reliability, and objectivity as a means of validating qualitative research (Huttunen & Kakkori, 2020). However, Galli et al. (2021) purported that content, construct, internal, and external validity represents research validation.

According to Galli et al. (2021), content validity refers to considering the universe of all possible items while collecting the possible variable candidates, such as literature and population sample for the study. Construct validity shows how the findings reflect the content of the constructs in the phenomenon investigated. Internal validity ensures that the study conducted represents the truth concerning the phenomenon investigated.

Finally, external validity refers to the generalizability of the research.

Along with validity, research completeness or rigor should be evident. Rigor refers to the completeness of the research process for the study so readers can validate what researchers have done and analyze the choices they have made during the research process (Ellis, 2019). Additionally, one of the core elements of rigor within qualitative research is identifying the influences of self within the research process, which is essentially the notion of being reflexive (Ellis, 2019). As a means to further strengthen

the content validity of my study, I plan to use an independent expert in the field of aerospace manufacturing (Blotenberg & Richter, 2020).

The common indicators for validity in qualitative research are (a) credibility, (b) transferability, (c) dependability, and (d) confirmability (Galli et al., 2021). Credibility refers to the quality of the paper and not the quantity of the data collected and addresses whether the findings presented are really what the researcher found (Ellis, P. (2019). Credibility also refers to the judgment of whether the research manages to express the participants' feelings and opinions (Galli et al., 2021). Transferability refers to the extent to which the research achievements can be transferred to other contexts or can be generalized (Galli et al., 2021). Huttunen and Kakkori (2020) noted that the lack of external validity or transferability does not diminish the quality of qualitative research since external validity, transferability, and generalization cannot be standard validation criteria for every form of qualitative research. Confirmability refers to whether the data analyses were coherent and whether the interpretations based on that data were fair (Haven & Van Grootel, 2019).

Data saturation addresses the number of qualitative interviews that are enough (Guest et al., 2020). Generally, saturation attainment achieved when collecting qualitative data through interviews and analyzed thematically, and no new themes are evident (Fofana et al., 2020). Data saturation is the conceptual yardstick for estimating and assessing qualitative sample sizes; that is, saturation is often described as the point in data collection and analysis when new incoming data produces little or no new information to address the research question (Guest et al., 2020). I plan to use the data coding process

use two other authors to check the results attempt to reach a consensus to ensure intercoder reliability (Galli et al., 2021).

Transition and Summary

In Section 2 of this study, I presented the description of the project designed to address the lack of strategies to improve nonconformance in the aerospace manufacturing industry. This description includes the role of the researcher, participants, the research method, the research design, population and sampling, ethical research, data collection instruments, data collection technique, data organization techniques, data analysis, and the reliability and validity. In Section 3, I presented the findings of the study, the application to professional practice, the implications for social change, recommendations for action, recommendations for further research, a reflection on my experience within the DBA Doctoral Study process, and a conclusion of the study.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this qualitative multiple case study was to explore strategies that successful aerospace manufacturing leaders use to reduce the cost of nonconformance of parts that result in scrap and rework during the manufacturing process. I conducted face-to-face, semistructured video conference interviews to gather data from four aerospace manufacturing managers who represented nine different aerospace manufacturing organizations within the contiguous states of the United States. In a 3-month period, these four individuals, out of 63 contacts, were the only participants matching my criteria and willing to participate in my study. P1 previously worked for and reflected on experiences from organizations O1 and O2. P2 also drew experiences from O2, and shared experiences from his previous employment at O3, O4, and O9. P3 shared experiences from past employment at O3 and current employment at O8. P4 worked at O5 and currently works for O6.

The four main themes that emerged from the data analysis were (a) establish quality improvement goals associated with problem-solving strategies, (b) adequately address employee resistance through buy-in, (c) increase the use of cross-functional teams and collaboration, and (d) ensure there is leadership commitment to make quality change initiatives permanent. All participants underscored the importance of implementing quality improvement strategies supported by industry-proven problem-solving techniques such as fault trees, fishbone diagrams, and 8Ds. To ensure that quality improvement strategies are effective, the participants agree that addressing employee

resistance through well-thought-out employee engagement tactics help ensure successful organizational change and buy-in of new ideas. Additionally, the participants emphasized that leaders' commitment to quality change initiatives sends top-down indicators that quality improvement is the basis of organizational success.

Presentation of the Findings

One overarching research question guided this study: What strategies do successful aerospace manufacturing industry leaders use to reduce the cost of nonconformance of parts that result in scrap and rework during the manufacturing process? After the data were collected and analyzed using NVivo R1 software, four themes emerged from the data analysis: (a) establish quality improvement goals associated with problem-solving strategies, (b) adequately address employee resistance through buy-in, (c) increase the use of cross-functional teams and collaboration, and (d) ensure there is leadership commitment to make quality change initiatives permanent. The findings from this study aligned with the 8D problem-solving technique conceptual framework and supported many of the peer-reviewed studies from the literature review.

As shown in Table 3, each theme that emerged from the data collected can be found multiple times in four or more stages of the 8Ds process. The fishbone diagram, 8Ds, pain index, measurement of the problem, analyzing the problem, fault tree, and six sigma were associated with the 8Ds team approach, 8Ds root cause assessment, and the emerged problem-solving theme. Buy-in, teamwork, cross-functional teams, and sustained corrective action were associated with 8Ds develop corrective action step, 8Ds team approach, 8Ds corrective action sustainability, the emerged employee resistance

theme, and the collaboration theme. Organizational culture, leadership, commitment, and communication were associated with 8Ds implementation, 8Ds prevention of reoccurrence, and the emerged leader commitment theme.

Table 3

Emerged Themes Compared to the Conceptual Framework

8Ds	Problem-solving strategies		Employee resistance		Collaboration		Leadership commitment	
	P	D	P	D	P	D	P	D
Team approach					15	113		
Define problem	32	30						
Develop corrective action	22	112						
Analysis of root cause	21	110						
Permanent or sustainable corrective actions			17	2				
Implementation and validation corrective actions					9	106	3	2
Prevent the reoccurrence of the problem			17	2			133	48
Appreciation of the team's effort							10	10

(#) = Number of times a participant (P) commented and how many documents (D) were quoted (problem-solving strategies, employee resistance, collaboration, and leadership commitment)

Theme 1: Identify and Implement a Specific Problem-Solving Strategy

All the participants mention the importance of utilizing problem-solving techniques. Though participants did not articulate the need for the same problems-solving tools, each participant did indicate that developing a problem-solving strategy such as the 8Ds, the fault tree, or the fishbone diagram was important. The need for a problem-solving strategy was the first theme emerging from the study after analyzing the data. P2 favored a problem-solving strategy that involved using the pain index:

So, I mean. You can't chase everything. Um, so I have found the creation of a pain index, which essentially measures the not only the cost of scrap, the financial cost, but also how much pain does it cause the organization as a result of that scrap? Some of those factors such as organizational stress, capacity constraints, and impact to the customer are all measures that can be calculated into a pain index.

The pain index is similar to other measures of risks like standard deviation or tracking error. However, the difference is in the definition. The pain index measures risk as losses in terms of depth, duration, and frequency (Odo, 2018). P4 experienced successful problem-solving strategies with the use of the fault tree, the fishbone diagram, and 5 Whys:

A full tree typically will feed into your PFMA [Process Failure Mode & Effects Analysis]. Familiar with that, and then that would be how we would proactively try to identify any risks and mitigate those actual when actual scrap activities happened, and we would usually start with a fishbone or 5 Whys or something

like that and use that to drive us revisiting our fault tree and to see what did we miss.

The fishbone diagram and 5 Whys are subcategory tools for 8Ds. A fault tree analysis accurately seeks out the quantitative relationship between accidents and problematic symptoms and root causes (Cui et al., 2016), whereas the 5 Whys is an iterative interrogative problem-solving tool used to explore the cause-and-effect relationships underlying the root cause of a particular problem (Gangidi, 2019). A fishbone diagram resembles the form of a fish, with the head representing the effect and the body with bones representing the causes of known problems. Problem-solving teams use the bones to identify possible major categories causing known problems. Teams then use tools such as 5 Whys to narrow the broader category to a specific root cause (Girish, 2022). When combining the two techniques, the framework of the fishbone diagram becomes the starting point. The structure is dependent on the event, which defines the major categories. After establishing the categories, team members keep asking “why” until the root causes are identified (Mateos & Place, 2021). To be considered an effective tool, the tool should complement problem-solving techniques such as 8Ds to address the broader dynamics for finding permanent solutions to quality problems.

P3 stated, “In some cases, we would use 8Ds. You know, effective corrective action requires the identification of the root cause. And what we have tended to see is that the root cause tends to be a repeat of the description of the problem.” P1 stated,

8Ds is a very current and a very popular one (problem-solving tool). 5 Whys is another one. Fishbone diagrams, which is synonymous with what’s called an

Ishikawa diagram or cause and effect analysis. All of those really those three are really the same tool. They're all effective. If an organization is serious about them.

O1's D3 illustrated how 5 Whys and a fishbone diagram are used together under the 8Ds problem-solving technique. The document was created by O1's problem-solving teams to address value chain competitiveness. The document provides direction for properly using the 8Ds technique and associated tools such as the fishbone diagram and 5 Whys. This technique along with lean principles allowed the leaders of O1 to develop a culture around problem-solving and lean manufacturing thinking.

Quality improvement strategies involve using different tools and techniques and applying the appropriate tool for improvements such as the beforementioned pain index, 5 Whys, or fault tree. Using these quality improvement tools in some processes helps determine the root cause of quality problems (Ershadi et al., 2018). There cannot be a one-size-fits-all definition of six sigma core concepts (Prashar, 2014). P1 directed me to an internal news release, O1's D1, that evolved into a public article release. D1 showed how O1 identified two critical issues via a root cause analysis and intense collaboration between departments and countries. Transparency was necessary for the company due to the concerns of O1's leaders. However, the problem-solving techniques allowed leaders of O1 to mitigate the quality issue. Relying on tools such as 5 Whys and the fishbone diagram as part of the 8Ds problem-solving technique enabled O1 leaders to find the root cause of their quality problem.

The 8Ds method is only one model for solving problems requiring an in-depth investigation to determine the root causes (Realyvásquez-Vargas et al., 2020). 8D is an appropriate problem-solving tool for issues related to the cost of poor quality. Previous research (e.g., Realyvásquez-Vargas et al., 2020; Sharma et al., 2020) suggested that the 8Ds problem-solving method is robust enough to stand alone regarding quality concerns within an organization since the 5 Why and the fishbone diagram are subcomponents to the 8D process (Realyvásquez-Vargas et al., 2020).

Theme 2: Identify and Mitigate Employee Resistance

Employee resistance has many causes that appear to involve buy-in, collaboration, and communication. Leadership must be clear when communicating change. Leadership and others who are part of the problem-solving effort should consider data to prove that changed in the form of quality improvement is required. Data should also be used during the validation process to secure buy-in to justify the solution. P1 stated,

Initiatives became a program of the month that were announced amid, marching bands and great exhortations, and everyone thought that this program was going to be the one and we're really going to get it right this time. Whether it was the workforce outlasting management or just genuinely poor execution on the part of management, the inconvenient truth is that these programs oftentimes fizzled and fell flat. This could be prevented through thorough and clear communication from a committed leadership team.

The perspective of P1 illustrates the failure of management to garner buy-in through communication or other means when implementing change due to quality improvement efforts. P4 stated,

In general, I find that the results speak to the method. So, if you can get them to buy it (the change rationale), show the results that have been effective. I've always been directly responsible; I've had anywhere from two to 20 employees to work these issues. Um. Where we meet resistance usually is when it comes to discussing, you know. Things are closing costs for you're trying to get those approved by operations or engineering or whatever, and that's where really having a data, the cost of one quality metric, those sorts of metrics that scrap dollars, you can show that you just have a cost benefit there. And that's where I've been able to get traction.

P1 went on to explain that problem-solving training and greenbelt training were implemented to address employee resistance primarily through increasing effort at an organizational level to gain buy-in from employees before pushing solutions. O2's D5 consists of seven binders of material to emphasize building trust, communication, and frequent check-ins as a way to mitigate employee resistance regarding quality change initiatives.

Employee engagement should be the leader's top priority when addressing many organizational issues, particularly the sustainability of quality improvement projects. Whether due to business acquisition or process improvement, employees expect change but managing the uncertainty, typically associated with substantial organizational change,

requires managers or business leaders to articulate the reasoning to understand the intended changes (King et al., 2020). P2 stated,

As the quality leader, there's nothing more valuable than having the highest person in the organization be the champion, you know, the quality person shouldn't have to be that champion. So, there were cases where we had very senior executives that were resistant that were stuck in a different mindset and they were given essentially one opportunity. And then after that, there were a number of terminations made by that CEO on the spot, and he did it for a reason, and it was to send an organizational message that we're not playing around. We have a mission to fulfill. And this is a manufacturer that does both commercial and military stuff and space stuff. So, there's, you know, there's a big mission there and it worked.

The 8Ds methodology is used to mitigate employee resistance with three of eight steps: (a) permanent or sustainable corrective actions, (b) implementation and validation of corrective actions, and (c) prevention of any reoccurrence of the problem. Employee resistance can sabotage these three steps by preventing sustainable corrective actions from being implemented and preventing the reoccurrence of behaviors at the root of the problem. Managers are the focal point of responsibility for motivating and training individual employees to acknowledge and mitigate factors that hinder the successful outcome of transitions, such as employees' resistance to change (Pană & Kreye, 2021). Top managers and middle managers need effective strategies to mitigate employee resistance. Middle managers provide a conduit for employees to accept change. However,

they confront the dual challenge of providing top management reasoning behind process improvement change while implementing changes they did not design and may not understand or disagree with (King et al., 2020).

Theme 3: Identify and Exploit Collaboration

Collaboration is important to the overall effort to problem-solving. Collaboration is at times, intra-departmental or organization, other times it is inter-departmental or organizational. There are times that engineering and procurement entities within the same organization need to work together to identify and solve problems. There are also times where engineering groups from different organizations within the aerospace industry must collaborate for product improvement, process improvement, and problem-solving. O2's D2 is an 8D problem-solving guide associated with the aerospace engine supplier quality strategy group reference manual that supports the SAE AS13100 standard:

The Aero Engine manufacturers [O1] and [O2] began a collaborative project to drive rapid change throughout the aerospace engine supply chain, improving supply chain performance to meet the challenges faced by the industry and the need to improve the quality performance of the supply chain.

The Aerospace Engine Supplier Quality Standard, O1's D2, revealed collaboration at an industry level that includes four aerospace engine manufacturers to improve quality within the supply chain using the 8Ds problem-solving method. O1's D2 also stated, "The intent of the AESQ [Aerospace Engine Supplier Quality] standard is to increase quality standards across several manufacturers and suppliers to achieve a harmony within the collaboration effort," also:

The vision of AESQ is to establish and maintain a common set of quality requirements that enable the global aero-engine supply chain to be truly competitive through lean, capable processes, and a culture of continuous improvement.

Collaboration emerged as a theme that includes a discussion of collaboration, cross-functional teams, and the right team mix or size. Forming a team is the first element involved in the 8Ds problem-solving technique, thus alluding to the benefit of teamwork and collaboration. According to a study by Sankaranarayanan et al. (2021), some of the benefits perceived by their participants were achieving consensus, building on each other's ideas, and willingness to collaborate for complex tasks. P1 stated,

We adopted a philosophy of taking diagonal slices of people off of the shop floor and empowering them to brainstorm, categorizing things, and then empowering them to make the decisions of not only what were the most likely causes of scrap, rework and repair, but also working to give them the tools on a on a daily basis in their job to make the improvements as a site director.

O1's D1 indicates how necessary collaboration can be when solving quality issues. However, most of the collaboration occurred primarily within the engineering group. There was also a reliance on external entities such as manufacturing and supply. This type of collaboration leads to consensus and agreement. A single perspective or consensus is possible through collaborative interactions of several different points of view originating from shop floor employees, support services, and management (Sankaranarayanan et al., 2021). When it comes to generating a consensus, the size of the

team or problem-solving group does matter. P1 stated, "Should every person in the factory or on every shift be involved in the problem-solving group? No, that becomes analysis paralysis." P2 stated, "The one strategy that is overwhelmingly successful regarding group collaboration is the one that engages constituents within the organization that have the influence and resources to make a difference." P3 suggested that the ability to influence and provide resources appears to indicate management, but it also affirms that a representation of a cross-section of employees facilitates the collaboration effort through diverse influence and resources:

As an example, when doing corrective action, making sure that the right people, cross-functional teams are involved in the collaboration effort, and not too large of a group, not too small of a group. And then, you know, there's skin in the game, you know? And you know, how do we make sure that this doesn't happen again becomes the mantra for the group as opposed to how do we, you know, how do we fix this immediate problem?

Collaborative problem solving is practical for dealing with conflicts among members within a process improvement project since there is an understanding that these members are responsible for the implementation outcome (Cheng et al., 2020). However, through the collaborative process, the individual team members must coordinate their ideas and perspectives to produce, structure, and maintain a collective problem-solving model for a solution. Additionally, one of the central pillars of collaborative problem-solving is the discussion and argumentation of knowledge to reach a consensus on ideas or concepts (Eiris et al., 2022).

Theme 4: Identify and Leverage Leadership Commitment

The commitment of leadership efforts towards making quality change initiatives permanent is the primary to successful and sustainable problem-solving solutions. Leadership commitment legitimizes the culture change that is necessary to make quality improvement initiatives stick. O1's D3 reveals how important leadership is and the impact of leaders and managers in the process improvement effort. O1's D3 stated, "The act of ensuring there is a structured approach to problem-solving contributes to the sustainment of quality failure solutions," and:

Leaders are responsible for creating an environment of support that enables employees to solve problems. Regarding process improvement using 8Ds, Lean Six-Sigma, or any other problem-solving tools, the support and leadership style are required components to implement successful and sustainable organizational change.

P1 stated, "Regardless of which tools were selected, getting everyone involved in the process such as managers or in many cases, engineers who think that they have all the answers, they're almost always wrong." O2's D4 states,

Rather than command and control, there's a focus on clearly defining roles and responsibilities and encouraging and empowering people down the org chart to take independent action, without worrying about being blamed for failure, and to freely communicate to higher ups.

As the collaboration team, which should include leadership, look at data, they may see that initial concerns were merely perceived problems and not issues to be prioritized.

Furthermore, describing issues with data increases trust and buy-in from other members of the leadership team (Andreoli & Klar, 2021). P3 stated,

Upper management want to see color charts, they don't want to get into the details. And so, if you can accurately represent the need for change through data. or system performance, you can say, look, this is what we're seeing. And here's the supporting evidence. This has the potential impact of helping management to apply appropriate resources to problems.

P2 stated,

Problem-solving solutions frequently would require capital improvement. And so again, the quality organization would not be the one with a capital improvement budget. So, the sustainment factor would be trying to get the general managers or leadership who are responsible for the operations involved and showing to them how it was beneficial to them. So again, the endeavor had to be meaningful. To all of the key constituents in the value stream.

Continuous improvement is the main aim for any organization to help them achieve quality and operational excellence and enhance performance. How leadership responds to that challenge can make a difference (Laureani & Antony, 2019). In some cases, leadership refuses to take responsibility. P3 stated, "Management has a tendency to say, well, it's not our fault, it's people not following our procedures as opposed to saying, you know, what else can we possibly do? To ensure that, you know, the landing gear is perfectly braced." P2 stated, "There were cases where we had very senior executives that were resistant that were stuck in a different mindset."

Level 5 leadership and Six Sigma leadership are two new leadership theories. Level 5 leaders display compelling humility, putting the organization's interests ahead of their own, a strong commitment, and the capacity to bring out the best in others (Laureani & Antony, 2019). They are a mix of personal humility and iron will. This type of leader is similar to authentic leadership and has some elements of transformational leadership. Six Sigma bases leadership on the idea that leadership is a learnable combination of balance and flexibility that drive performance, data-driven decisions, and a constant customer focus (Laureani & Antony, 2019).

According to Laureani and Antony (2019), the term Lean Six Sigma refers to integrating Lean and Six Sigma business improvement methodologies, where *Lean* is a process improvement methodology used to deliver products and services better, faster, and at a lower cost. While Six Sigma is a data-driven methodology used to achieve stable and predictable processes, this data-driven methodology can assist in focusing leadership and other key players on issues that matter. When prioritizing is data-driven, the team and leadership spend less time on issues not supported by evidence and thus move on to other inquiry cycles (Andreoli & Klar, 2021).

Theme Summary

All of the manufacturing executive participants were associated with quality and were from similar levels of management within the aerospace industry. These participants also possessed similar levels of education and years of experience. Data were collected via semistructured interviews and participants provided supporting documents. I analyzed the data using NVivo 11 software. The findings from this study aligned with the

conceptual framework of 8D for problem-solving technique and supported some of the peer-reviewed studies from the literature review section. As shown in Table 3, each theme is present throughout the 8Ds steps. The four identified themes also confirm findings with other peer-reviewed studies from the literature. When implementing a quality improvement change initiative, problem-solving strategies, employee resistance, collaboration, and leadership commitment are all required (Realyvásquez-Vargas et al., 2020). All four participants expressed the significance of all four themes that emerged from this study

Application to Professional Practice

The results of this study may allow leaders, managers, and associates to focus on strategies that will address the cost of poor quality within the aerospace industry. Any developed strategy must be sustainable, which is possible using a tool like 8Ds and pairing that tool to the appropriate leadership style. The overall goal of the 8Ds methodology is to define the root cause of the issue, develop containment measures to defend consumers from the problem, and take appropriate steps to protect similar issues in the future (Elangovan et al., 2021). Along with leadership commitment, 8Ds provide leaders with a structure, discipline, and operations that will assist in sustaining quality improvement solutions (Elangovan et al., 2021). While this study focuses on the aerospace industry, this study is beneficial to business leaders in all industries.

The literature from this study also supports how aerospace industry leaders can sustainably implement quality improvement initiatives. The interviews and company documents support the idea that the successful implementation of new quality

improvement initiatives is necessary to use the correct problem-solving strategy, properly addressing employee resistance to change, effective collaboration, and leadership commitment. The aerospace industry is competitive, and the fast-paced advancement of technology makes competition more intense, thus; making the future of aerospace manufacturing uncertain. Ensuring that quality is a top priority can be an aerospace manufacturer's best defense against the cost of poor quality (Nourani et al., 2020). The 8D problem-solving technique provided the conceptual framework for this study. Some participants mentioned 8Ds as part of their strategy for identifying and improving quality issues. This framework and the mitigation of employee resistance, collaboration, and leadership commitment create a foundation for change within an organization. These themes align well with the 8Ds model for problem-solving.

Implications for Social Change

The findings of this study may help businesses in the aerospace manufacturing sector successfully implement change initiatives that improve aircraft safety by improving quality in the manufacturing process. Improvements in aircraft safety may contribute to positive social change by reducing aviation accidents and keeping communities safe from loss of life. Many consider flying one of the safest modes of transportation; however, aviation accidents have devastating effects regarding human fatalities and structures on the ground. These accidents can erode consumer confidence (Fardnia et al., 2020). Making quality a priority in every corner of the aerospace industry can silence critics who argue that airlines sacrifice safety for profits (Fardnia et al., 2020).

Industry leaders who can successfully reduce the cost of poor quality of parts, will also be successful in boosting consumer confidence in air travel.

Recommendations for Action

Leaders in aerospace manufacturing may consider the findings in this study to guide them through reducing the cost of poor quality through a sustainable process improvement initiative. Industry leaders should consider identifying an appropriate problem-solving strategy and strong cross-functional teams. They should also mitigate employee resistance when quality initiatives require significant organizational change and are prepared to show commitment to actions supporting change quality improvement implementation.

The first recommendation is that there should be a single-minded focus on how a quality problem should be solved. What strategy is the best strategy for the organization? What tools will support this strategy in a complimentary way? An excellent problem-solving strategy will serve as a framework through the quality improvement process. The problem-solving methodology should be thorough and address all phases of a process improvement initiative requiring changes within an aerospace organization.

The second recommendation involves the active mitigation of employee resistances related to dramatic cultural changes/process changes within an organization. Effective communication and seeking buy-in for new ideas can differentiate between successful change initiative implementation and a failed attempt to implement change. While it is not necessary to have 100% input from employees regarding change solutions, employees at all levels of the organization must have a clear understanding of any new

change initiatives. Leaders should communicate the change in terms that affected stakeholders can understand. Creating cross-functional teams to facilitate collaboration on problem-solving solutions also facilitates the communication process.

The third recommendation focuses on leaders and their commitment to change. A leader's commitment to organizational change for any reason is a critical component to the sustainment of that change. Without the commitment from organizational leaders and managers, initiatives such as quality process improvement will fade, causing a reoccurrence of quality problems. Leaders must lead organizational change and utilize effective leadership styles that foster trust and transparency. Leaders' commitment through all phases of a change methodology such as 8Ds sends a clear message of how important quality is for organization success.

Aerospace manufacturing leaders may use these recommendations to implement sustainable organizational change regarding quality improvement. I hope to share and disseminate this study through different distribution outlets such as business journals, academic databases, and Aerospace journals. I plan to take steps to make this study available to fellow students and researchers. I hope that aerospace manufacturing leaders will gain a more in-depth understanding of the need to fully develop sustainable problem-solving strategies to address the cost of poor quality.

Recommendations for Further Research

My findings may assist aerospace, and other industry leaders see that quality goes beyond profit and loss. Quality issues can also affect suppliers, consumer confidence, and safety commercially and in defense. Other industries can use the 8Ds technique.

Problems with quality exist in all manufacturing industries and associated supply chains. Repeating this study in any of those industries would be beneficial. The findings would likely reflect similar conclusions because quality problems, collaboration, employee resistance, and leadership are not unique to any industry, but there are a few limitations.

8Ds addresses most of the critical elements required for successful organizational change initiatives, such as defining the problem, establishing teamwork, addressing employee resistance, and ensuring a strong commitment from organizational leaders. However, leaders should consider adding more emphasis on validating the solutions conceived by the problem-solving teams. Validating may involve conducting a quantitative study that examines the implementation results of problem-solving solutions. I have seen many failed attempts at change initiatives throughout my military and aerospace manufacturing career. I have also seen successful organizational change. Whether the quality issues that cause change initiatives are due to other corporate challenges not mentioned in this study, change is inevitable and is required for companies to remain competitive. I believe that my study will add to the limited body of work for the aerospace manufacturing industry due to the lack of relevant data (Nourani et al., 2020).

Reflections

My experience within the DBA doctoral study process revealed that restricting a topic to a specific framework is necessary and limiting. The framework's constraints allow a researcher to focus on a narrow point of view of something vastly more extensive and would probably take a decade or more to cover adequately. Nevertheless, focusing on

a specific framework is useful and adds value to the subject that was not necessarily there before each study. I thought I knew 90% of what there was to know regarding quality deficiencies within the aerospace industry; now, I realize that what I knew only scratches the surface. Additionally, the participants for my study were similar in organizational status and experience. However, their perspectives on addressing issues like quality improvement differed with large category overlap. This dynamic tells me that the lens through which we perceive issues does matter and can significantly impact how leaders and managers successfully or unsuccessfully approach a problem. A roadmap like 8Ds can reduce the variance of outcomes and increase the likelihood of success.

Conclusion

The purpose of this qualitative multiple case study was to explore strategies that successful aerospace manufacturing leaders use to reduce the cost of nonconformance of parts that result in scrap and rework during the manufacturing process. The cost to provide quality is the sum of the cost of conformance and nonconformance; nonconformance is the failure cost associated with not operating to the product or process requirements (Taaffe et al., 2014). Quality is the value of the products as perceived by the customer through conformance and to the degree that an engaged workforce can hold to that conformance level (Oschman, 2019). In order to maintain high conformance or quality excellence, strategies to address quality problems should be in place.

The four themes that emerged from this study (a) establish quality improvement goals associated with problem-solving strategies, (b) adequately address employee resistance, (c) increase collaboration, and (d) ensure leadership commitment can help

maintain a culture of quality excellence within the aerospace industry. However, the themes previously mentioned are also analytically generalizable to broader industry research (McLeod et al., 2021). Utilizing 8Ds as a methodology for problem-solving will directly impact reducing the cost of nonconformance, primarily due to internal failures (waste, scrap, or rework) (Taaffe et al., 2014). The findings of this study can serve as a guide for leaders to develop strategies to address quality improvement issues and implement sustainable change initiatives to make quality improvement solutions permanent.

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Appendix: Interview Protocol

Interview Protocol	
What I will do	What I will say (script)
Introduce the interview and set the stage. This will be done away from the facility or via teleconference.	My name is John Lloyd, Jr. and I am conducting a study to address and explore strategies to reduce nonconformance of parts in aerospace manufacturing. I would like to learn about your experience regarding this topic using a series of predetermined interview questions.
<ul style="list-style-type: none"> • Watch for nonverbal queues • Paraphrase as needed • Ask follow-up probing questions to get more in-depth feedback. 	1. What have been the costs related to nonconformance of parts that result in scrap and rework during your organization's manufacturing process?
	2. What strategies did you use to identify and address the causes of those costs?
	3. How did you measure the effectiveness of the strategies?
	4. Which strategies were the most effective for reducing the cost of parts' nonconformance?
	5. Which strategies were the least effective for reducing the cost of nonconformance?
	6. How resistant were your employees to the strategies?
	7. How did you address employee resistance?
	8. What other information would you like to share regarding reducing the cost of nonconformance of parts that result in scrap and rework during the manufacturing process?
Wrap up interview thanking participant	Thank you for your time and valuable insight on this topic.
Schedule follow-up member checking interview	I would like to schedule a follow up with you after I review your transcript. I want to be sure that my synthesis of the transcript accurately reflects your thoughts and input.
Introduce follow-up interview and set the stage.	Good to see you again. Thank you again for taking the time to assist me with my study. Your input thus far has been incredibly valuable.
	Please see the copy of my synthesis for each question you answered.

Share a copy of the succinct synthesis for each individual question.

Bring in probing questions related to other information that you may have found that are related to the topic and adheres to IRB approval.

Walk through each question, read the interpretation and ask:

Did I miss anything? Or, What would you like to add?

1. What have been the costs related to nonconformance of parts that result in scrap and rework during your organization's manufacturing process? *(Succinct one paragraph synthesis of the interview interpretation TBD.)*

 2. What strategies did you use to identify and address the causes of those costs? *(Succinct one paragraph synthesis of the interview interpretation TBD.)*

 3. How did you measure the effectiveness of the strategies? *(Succinct one paragraph synthesis of the interview interpretation TBD.)*

 4. Which strategies were the most effective for reducing the cost of parts' nonconformance? *(Succinct one paragraph synthesis of the interview interpretation TBD.)*

 5. Which strategies were the least effective for reducing the cost of nonconformance? *(Succinct one paragraph synthesis of the interview interpretation TBD.)*

 6. How resistant were your employees to the strategies? *(Succinct one paragraph synthesis of the interview interpretation TBD.)*

 7. How did you address employee resistance? *(Succinct one paragraph synthesis of the interview interpretation TBD.)*

 8. What other information would you like to share regarding reducing the cost of nonconformance of parts that result in scrap and rework during the manufacturing process? *(Succinct one paragraph synthesis of the interview interpretation TBD.)*
-