

SOLE SOURCING RELIANCE

by

John S. Stammreich

Dissertation

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Business Administration

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Abstract

This qualitative research case study investigated the increasing reliance on sole-sourced critical defense components within the U.S. Department of Defense (DoD) supply chain network. This reliance has resulted in increased risks of operational units not achieving the agency's minimum operational readiness requirements as presented in the DoD Inspector General's Top 10 management challenges for the fiscal year 2020. The general problem to be addressed was the increasing reliance on sole-sourcing within the supply chain networks of government agencies and business organizations that have contributed to heightened risks of operational readiness reduction and manufacturing production delays. The purpose of this qualitative case study was to explore the strategies that some U.S. DoD contract officers use to reduce sole-sourced critical equipment components from the supply chain. The researcher framed research questions to focus on previous cases experienced by former or current U.S. DoD contracting officers. This strategy was implemented to gain their perspective on what factors they believe are contributing to the increasing reliance on sole sources for materials and resources. Eight interviews were conducted using purposeful sampling. The analysis of the interview data yielded three primary themes and seven sub-themes for consideration. The themes developed during this study are pertinent in discussing some potential causation based on their frequency among the eight interviews. The findings were connected to a substantial body of literature from academia, industry media, and DoD policies and procedures. Potential opportunities for improving the general business practices within the DoD and major defense firms were identified.

Keywords: defense, sourcing, government, contracting, aerospace

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Dedication

Many individuals have contributed to my academic and professional accomplishments; I am making these special dedications to those who instilled in me the necessary perseverance to complete this academic study.

To my paternal grandparents, my German Jewish grandfather, who I am proudly named after, refused to let his waist-down paralysis keep him from his God-given duties to his family. My Sicilian Catholic grandmother showed me what unconditional faith and love for our Lord and family should look like.

To one of my early aerospace supply chain management mentors, Bob Haffey, who taught me one of my most memorable counseling sessions. It was November 2002, in the parking lot of Building 154 at T.R.W.'s Space Park in Redondo Beach, you stated, "Not only are there things you do not know, but there are many things that you DO NOT KNOW that you do not know!" Your guidance and support for a head-strong individual who had so much to learn about the aerospace industry and supply chain management formed the foundation of my enthusiasm for government subcontracts management, and I will always be grateful.

To my brothers and sisters who make up the greatest United States Naval Academy class – the Class of 1992. Special callouts to those who started the journey with me at the Naval Academy Preparatory School in Newport, Rhode Island. My company mates from "Club 34 /Thirsty Third," my Navy Ultimate teammates, and all of those who have been with me through the highs and lows of my naval officer and professional career. So many to name, but a special dedication to one who has been with me from Rolling Hills High School, Boy Scouts, Order of the Arrow, USNA, and today – L.T.C.O.L. Joe Vinso, U.S.M.C. (Ret.). No better classmate embodies our class motto, "Fortune Favors the Bold!"

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While there are so many that have assisted me during this academic endeavor, I want to start by expressing my sincerest appreciation to my wife, Andrea, and my daughters, AnneMarie and Violet, who have sacrificed so much while I pursued this feather in my supply chain management cap. My greatest day will always be May 15th, 2000, when I suddenly saw my future more clearly than ever and have been truly blessed that Andrea has been my better half of it ever since. My greatest accomplishment will always be getting her to say "Yes" exactly one year later.

I need to give special recognition and appreciation to my parents, who inspired me to continue pursuing education and knowledge and ensured I had the financial resources to complete this effort. My commitment to them is to continue paying this forward to the future generations of our family. I want to acknowledge my father, an Apollo 11 lead engineer and significant contributor to numerous other spaceflight platforms and missions, who inspired me early to seek out a purpose greater than myself. While I did not pan out well as an aerospace engineer, finding my calling in combining our mutual love for this nation, our commitment to its defense, and my preferred skill sets in supply chain management has brought me to the profession that I love. My mother, who instilled in me that being well-educated was the best way to improve one's quality of life. She survived the slums of the Bronx, then put aside her academic pursuits to support my father's professional ones. She later earned her degree from California State University (Fullerton) with three young children in tow. She continually taught me that all challenges can be overcome with hard work and a strong education. To her, I always say, "I'm ALMOST done," but she knows I'm just getting warmed up!

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Section 1: Foundation of the Study

This qualitative multiple case study examined significant issues created within the Department of Defense (DoD) agency due to its increasing reliance on sole-source manufacturers and suppliers, including potential threats to operational readiness and significant delays in contractual performance and deliveries. Unlike the selection of a single supply source among multiple viable providers, sole-source suppliers have been identified as possessing a unique ability to provide a product or service that no other supplier is capable of offering (Li & Debo, 2009). Throughout the progression of this study, the author identified critical moments when DoD contracting officers proceeded with a supplier as a sole-source provider due to either government requirements or unique supplier capabilities (Namdar et al., 2018). This study aimed to investigate potential opportunities to address the sole-source reliance issue that the DoD Inspector General identified within its Top-10 Management Challenges for the fiscal year 2020 (U.S. Department of Defense, 2019). Sole sourcing itself does not result in detrimental situations for the prime contract manufacturer; however, the risks of higher costs, delayed schedules, and contract terminations increase significantly when the competitive environment is removed from the DoD contracting relationship (Defense Standardization Program Office, 2006). Contractual obligations dedicated to one supplier to fulfill all forecasted demand of a product or commodity among a field of qualified suppliers (known as single sourcing) do not generate the same detrimental reliance issues. At least one other qualified supplier must be capable of replacing the selected one (Li & Debo, 2009; Namdar et al., 2018). This investigation into the impacts of sole-source reliance on DoD programs became important when sole-sourcing was identified as a significant contributor to decreased operational readiness. The DoD's Inspector General

identified sole-source reliance among its top 10 DoD management challenges in the fiscal year 2020 (Office of the Inspector General, 2019).

Background of the Problem

The sole-sourcing reliance problem caused primarily by diminishing supply sources, technological obsolescence, global material shortages, or a combination thereof is not unique to the DoD agency. The detrimental effects of sole-sourced requirements within the agency have raised the issue to its top 10 DoD management challenges in 2020 (U.S. Department of Defense, 2019). This escalation has occurred despite the 2006 establishment of a dedicated program, the DoD Diminishing Manufacturing Sources and Material Shortages (DMSMS) program. This initiative addressed this issue and implemented better sourcing strategies on DoD prime contracts since its inception (U.S. Department of Defense, 2006). The program requires DoD prime contractors to identify any single source items within the bills of materials for proposed hardware, including those that the U.S. government has not granted data rights. Furthermore, it includes a strategic plan for their continuous supply during production and sustainment phases (U.S. Department of Defense, 2006).

The term "sole-sourcing supplier relationships" refers to one supplier becoming the only qualified provider of an essential product or commodity through contractual terms or business environmental conditions (Lewis et al., 2013). Critical supply chain risks of sole-sourcing arrangements can include single-point supply disruptions (commonly known as "choke points") and reduced product design autonomy, including reduced opportunities to utilize technological advances in related product lines (Lewis et al., 2013).

Li and Debo (2009) discussed the different strategies that must be in place when a manufacturer chooses between single-sourcing important components or setting up multiple

suppliers for the same components or materials. Strategic trade-offs between these two options must be weighed, including when competitive price competition benefits multiple suppliers. This process may be offset by "costs of future supplier competition" when minimum quantity purchases may be required by each participating supplier, driving up initial investment costs (Li & Debo, 2009, p. 448). Different criteria must be prioritized when a single-source arrangement is being pursued over a multiple-source procurement to reduce the risks of the single-source arrangement becoming a sole-source issue (Bevilacqua et al., 2006). Specifically, "technical support and product reliability are more important in the case of single-source purchasing situations" (Bevilacqua et al., 2006, p. 15).

In 2011, the Government Accounting Office (G.A.O.) found that the DoD "does not effectively consider trade-offs among cost, schedule and performance when analyzing system requirements" (Hague et al., 2015, p. 6083). Hague et al. (2015) identified the need for the DoD, if unable to avoid the risks of sole-sourcing a component, to adopt an "availability-based sole supplier selection framework" (p. 6083). This strategy would assist with weighing critical source selection criteria, including component availability and the past historical reliability of proposed suppliers. They showed the importance of reducing the inherent risks of sole-sourcing reliance, if it becomes inevitable, by selecting suppliers capable of sustaining required levels of availability that take all three of the G.A.O. criteria into account (Hague et al., 2015).

The sole-source reliance issue is also a significant challenge facing manufacturers that produce "sustainment-dominated systems" for high-reliability requirement industries such as health care, public utilities, aerospace, and defense (Classi et al., 2018, p. 69). These systems require a larger amount of post-production maintenance and upkeep, including chemical replenishments and wear-and-tear components, and system upgrades such as software

improvements and adaptive improvements based on rapidly changing industries. By addressing this issue earlier in their product design processes, manufacturers seek to minimize many of the underlying problems of sole-source reliance. These problems include component obsolescence, longer production lead times for critical components, and limited supplier sources that can affect the operational performance of their products (Classi et al., 2018).

Problem Statement

The general problem addressed was the increasing reliance on sole-sourcing within the supply chain networks of government agencies and business organizations, resulting in heightened risks of operational readiness reduction and manufacturing production delays. Sole-sourcing occurs when one supplier becomes the only qualified provider of an essential product or commodity, increasing supply chain risks such as single-point supply disruptions, resource demand limitations, and reduced product design autonomy (Lewis et al., 2013).

Sole sourcing had been broadly defined as any contractual commitment for one supplier to fulfill all current and future demand volume of a product or commodity among a field of qualified suppliers. This subset, known as single sourcing, does not generate the same detrimental reliance issues due to the availability of other qualified suppliers to replace the original supplier (Li & Debo, 2009; Namdar et al., 2018). Components and sub-assemblies that are sole-sourced or become sole-sourced are more likely to affect the timely downstream production of their parent assemblies, from small electronics to high-tech machinery and multi-million dollar aircraft. Sole sourcing has significantly affected the operational readiness of manufacturing businesses and government organizations, including the U.S. DoD agency (U.S. Department of Defense, 2019). The specific problem addressed is the increasing reliance on sole-sourced critical defense components within the U.S. DoD supply chain network, resulting in

increased risks of operational units not achieving the agency's minimum operational readiness requirements.

Purpose Statement

The purpose of this qualitative case study was to explore the strategies that some U.S. DoD contract officers use to reduce sole-sourced critical equipment components from the supply chain. Early attempts to address sole sourcing included Diminishing Manufacturing Sources and Material Shortages (DMSMS) programs implemented by larger manufacturers to identify components and materials at a higher risk of becoming unavailable or significantly scarce. These attempts limit a product's manufacturability (U.S. Department of Defense, 2006). This study provided visibility into the engagement by DoD contracts officers with the internal DoD's DMSMS program, as well as the practice of flowing down requirements for such a program implementation to its prime contractors when contracting for the large-scale purchases of critical defense equipment, hardware, vehicles, and platforms. The findings of this case study provided increased awareness of proactively implementing such programs and explained the major DoD issues when there is insufficient accountability for its proper implementation. Furthermore, the outcomes of this case study contributed to the literature on this topic by proposing recommendations for reducing the detrimental reliance on sole-sourcing by the DoD.

Nature of the Study

This study was conducted using a case study qualitative design approach to better understand the problems generated through increased sole-sourcing reliance by the U.S. DoD contracting officer community. The researcher interviewed former and current DoD contracting officers who faced business conditions that led to them making sole-sourcing decisions and then had to confront the issues that followed. The researcher structured the interview questions

to reveal how the DoD contracting officers were identifying and evaluating potential supply sources. Moreover, whether subjective influencers, both foreseen and unforeseen, weighed into some of their source selection decisions and whether potential threats of sole sourcing were identified and mitigated before their source selection decisions.

Discussion of Method

The three possible research methods were qualitative, quantitative, and mixed methods. Determining which research method to conduct depended significantly on the nature of the variables and the validity requirements of the findings (Khaldi, 2017). In all three research methods, the validity of a study must focus on whether its findings are applicable and accurate. The researcher must also give attention to data collection and analysis processes to determine whether those processes properly measure what the researcher is trying to quantify (Creswell, 2014). One difference in their conduct is how the validity of their studies is determined. In qualitative research, multiple strategies are utilized that share a characteristic of subjectivity that elevates the credibility of research findings and confirms whether the conclusions of those findings could be transferable to other groups (Creswell & Poth, 2018). Qualitative research encompasses open-ended observations and narratives collected through unrestricted methodologies such as interviews and ethnographies (Ahmad et al., 2019). The validity of quantitative research is determined through objective reviews of data verification within a controlled environment to confirm its dependability (Antwi & Hamza, 2015). These reviews explore the numeric patterns of collected data, either intrinsically structured or imposed through correlative assignment (Ahmad et al., 2019). If the researcher cannot produce the observations and findings in a controlled environment, and the data collection methods are imprecise, the quantitative research method would be inappropriate for this study (Creswell, 2014).

A mixed-method approach for this study would have addressed both qualitative and quantitative aspects of sole-source reliance by bounding investigations within the DoD to explore likely correlations between the most occurring sole-sourcing occurrences with the more impactful within the agency (Khaldi, 2017). Conducting mixed methods research for this study would have needed to be initially quantitative by identifying larger contributing factors utilizing recent incident data. Later, the researcher can proceed with targeted interviews or surveys addressing whether the subjects believe the contributing factors affected their operational performance. Mixed-methods research injects a higher threshold for reliability. It also requires quantitative research validity into subjective findings to aid those who are placing substantial trust in its accuracy and proposing recommendations that could be substantially impactful on an organization (Mayoh & Onwuegbuzie, 2015). This study did not delve into the quantitative analysis of sole-sourcing reliance within the DoD agency, remaining purely subjective; therefore, the mixed methods approach was unsuitable.

Discussion of Design

The qualitative research method has five possible designs: narrative design, grounded theory, ethnography, phenomenological design, and case study design (Creswell & Poth, 2018). This research focused on how the DoD's acceptance of component sole-sourcing within many of its critical hardware procurements has resulted in late deliveries, longer operational downtimes, or shorter product utilization periods. The DoD's acceptance of component sole-sourcing contributed to decreased operational readiness (U.S. Department of Defense, 2019). The findings from researching the selected case supported the sought-after theme of identifying opportunities to improve operational readiness within the U.S. DoD by mitigating the negative effects of sole-sourcing critical materials or, if possible, eliminating it altogether.

The narrative design was not appropriate for this research because narrative design focuses on personal experiences to gain insightful data and useful narratives about a qualitative phenomenon or a particular theme (Creswell & Poth, 2018). The grounded theory research design utilized data collected to develop a hypothesis of why a behavior is occurring. The ethnographic research design examines shared patterns of such behavior, often through observation and analysis of a group's internal interactions (Creswell & Poth, 2018). Addressing grounded theory and ethnography, the focus of this sole source reliance research was not on why it exists within the DoD but on how it is occurring and what can be learned from the experiences of DoD contracting officers. Due to no behavioral examinations, neither of these approaches was deemed appropriate.

The phenomenological design approach was considered a possible alternative for this research study. This design was most appropriate; the subjective experiences of multiple individuals can contribute to the increased understanding of a common issue or phenomenon without the need for the researcher to integrate their own experiences with the same or similar phenomenon (Creswell & Poth, 2018). This researcher sought to understand the common objective effects of the sole-sourcing reliance phenomenon, primarily through the experiences of DoD contracting officers, but with some direction of the research based on the researcher's own experience. The restrictions of the phenomenological design approach would have been more challenging to maintain than those of the case study design (Creswell & Poth, 2018).

When a researcher uses the case study design approach, they explore how or why an issue or a problem exists through real-life experiences of an entity or group of entities (Creswell & Poth, 2018). The existing problem for this research was sole-sourcing reliance, and the entities were the U.S. DoD contracting officers. Case study design depends significantly on the cases

being bound, well defined, and clearly describing certain parameters such as time, location, or sometimes a certain subset of individuals (Yin, 2018). However, it was also important that the case be free-flowing such that the researcher had little or no control over the events so that the research concentration could be on the case itself (Yin, 2018). This research was bound solely within the U.S. DoD contracting officer community, and the researcher had no control or influence in the growth of the sole-sourcing reliance issue within that community. The case study research design was the proper approach for this research.

Summary of the Nature of the Study

The combination of subjectively discussing common issues identified in sole-sourcing reliance by the DoD contracting officer community and how their experiences contribute to understanding those common issues is why the case study design approach was selected (Yin, 2018). The researcher examined these issues within the context of the overarching research question based on the researcher's own experiences. This study focused on a modern-day series of events that the researcher had little or no control over their occurrence. The research concentration was on the cases resulting from those events, an approach that defines case study design (Creswell & Poth, 2018). The researcher examined the specific business problem through the experiences and assessments of the United States (U.S.) Department of Defense contracting officers to increase subjective understanding and propose procedural recommendations. A qualitative approach was preferred over a quantitative methodology, which would have approached the problem by gathering sole-source contracting data and calculating objective findings regarding the effects of sole-sourcing (Creswell, 2014).

Research Questions

RQ1. What strategies do U.S. DoD contract officers use to reduce sole-sourced critical equipment components from the supply chain?

RQ1a. How is the U.S. DoD identifying current defense systems and platforms that contain components that are either sole-sourced or are at an increased risk of becoming sole-sourced due to a diminishing supply base?

RQ1b. How have the U.S. DoD contracting officers historically required prime contractors to address sole source reliance risks within the supply chain sections of their submitted proposals?

RQ1c. How has the reliance on sole-sourced hardware and components within the U.S. DoD supply chain network affected the organization's level of operational readiness?

RQ1d. Does the U.S. DoD have a current strategy to address the increasing reliance on sole-sourced materials and components?

RQ2. What are the trade-off effects of significantly reducing sole sourcing within the U.S. DoD supply chain?

Conceptual Framework

The researcher constructed the conceptual framework for this qualitative case study research was by combining key process steps within the U.S. DoD supplier sourcing process and the post-award contract performance process (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2020). Figure 1 shows three specific process steps the researcher found to contain higher risks of increasing sole-source reliance within the DoD supply chain network. This research expanded on previous literature about the DoD source selection process

by applying conceptual business theories to identify how the DoD contracting officers contributed, sometimes inadvertently, to the increased sole-source reliance issues.

The conceptual theories that this researcher used in this study were the theory of production competence, the theory of trade-offs, and the resource-based view. The theory of production competence (TPC), the most dominant in this process, has applicability throughout the DoD supplier sourcing process. It was initially proposed by Cleveland et al. (1989) and revisited by Vickery (1991), then extended in its application by González-Benito (2007) to the purchasing function. According to the base theory, a manufacturer's production competence requires more than simply expanding production capabilities; it requires prioritizing those capabilities to align with the proper business strategy (Vickery, 1991). González-Benito adapted the base theory to the purchasing function by asserting that the purchasing competence of an organization requires an alignment between its purchasing capabilities and its acquisition strategy (2007). The manufacturing and purchasing applications of this theory were relevant to this research.

The theory of trade-offs applies both to the competitive business strategies of manufacturers and to the prioritization of source selection criteria. The foundational concept is that "different competitive priorities are not always compatible, and therefore, companies focused on fewer competitive priorities will be more successful than those pursuing a wide range of competitive priorities" (González-Benito, 2007, p. 907). There are a few competitive priorities that are not only compatible but they can potentially complement each other. Generally, the theory holds that manufacturers trying to achieve too many objectives are less likely to succeed. A source selection team with too many minimum requirements will likely find fewer qualified suppliers capable of meeting all of them.

The resource-based view (R.B.V.) is a widely applied theory, as it relates to any field of study that looks at the resources of an organization, activity, or entity. It is generally defined as any asset, tangible or intangible, which provides value to its owner (Barney, 1991). Within the supply chain management field of study, R.B.V. considers an organization's resources and capabilities as its primary source of competitive advantage and core competence (Halldorsson et al., 2007). Among those capabilities are adapting to changing resource availabilities and customer demands, as well as the extended resources and capabilities of an organization's supplier network through strong business relationships and past performance (Halldorsson et al., 2007).

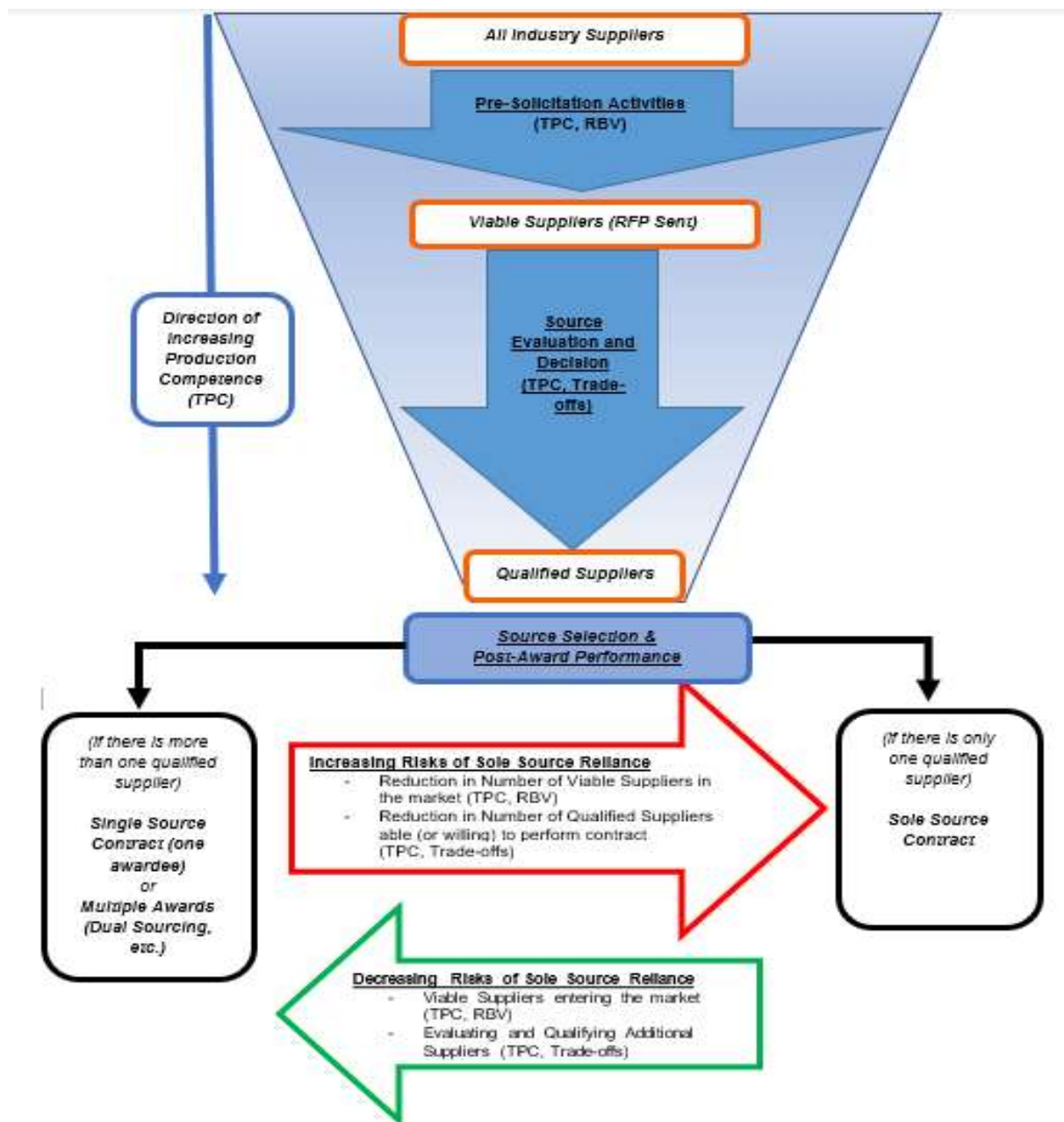


Figure 1. Relationships between the DoD source selection concepts and theories (TPC – theory of production competence, RBV – resource-based view, & theory of trade-offs)

Discussion of Pre-solicitation Activities

DoD contracting officers must conduct pre-solicitation activities before sending suppliers requests for proposals (R.F.P.s) to determine which industry suppliers are viable (Department of Defense, 2016). These procedures are explained throughout Chapter Two of the Defense Federal Acquisition Regulation Supplement (DFARS) Subpart 215.3 titled Source Selection Procedures (Department of Defense, 2016). As the theory of production competence (TPC) applies, DoD contracting officers lead source selection teams through these pre-solicitation activities. These activities include the development of source evaluation criteria, market research, and requests for information (RFIs) as necessary to determine which suppliers are viable or competent for solicitations (Department of Defense, 2016). Applying an R.B.V. perspective, the team generates the evaluation criteria of technical capabilities, resource availability, production capacity, and financial stability for each potential supplier, along with assigned weight percentages based on the importance of each (Wu et al., 2015). Once a list of competent suppliers has been compiled, the source selection team proceeds with soliciting R.F.P.'s to those suppliers most likely to provide responsive proposals (Department of Defense, 2016).

Discussion of Source Evaluation and Decision

Once quotes and proposals are received from viable suppliers, the source evaluation and decision process begin (Department of Defense, 2016). Extending its application of the TPC, the DoD source selection teams use their previously developed evaluation criteria to analyze each supplier submission and determine if each properly addresses all project requirements. This process includes technical specifications, mandatory government regulations, and budgetary limitations (Nair et al., 2015). Suppliers who provide proposals that respond to all project requirements or revise their original submissions to address all deficiencies satisfactorily are

designated as qualified suppliers for the requested products or services (Department of Defense, 2016). Suppliers who are either unable or unwilling to improve their proposals to fulfill their deficiencies are deemed nonresponsive to the solicitation and are removed from further consideration (Department of Defense, 2016).

Applying the theory of trade-offs to prioritize the competitive criteria, the source selection team reviews each proposal from qualified suppliers and ranks them based on their measured value (Imeri et al., 2015). Measured values are calculated through a combination of factors developed by the source selection team and are comprised of (a) a raw score for each factor and (b) an agreed weight percentage for that factor (Wu et al., 2015). The qualified supplier with the highest-measured value is the first invited to negotiate a proposed contract with the DoD contracting officer. If negotiations are successful, a contract is awarded (Department of Defense, 2016). Suppose the DoD contracting officer does not feel that negotiations with the highest-ranked qualified supplier are proceeding in the government's best interests. In that case, they can initiate negotiations with the next highest-ranked qualified supplier (Department of Defense, 2016). The DoD contracting officer can also break up the total contract award by negotiating with multiple qualified suppliers in the order of highest-measured values (Department of Defense, 2016). If only one supplier was designated as a qualified supplier and is subsequently awarded the complete contract award, the resultant agreement is designated as a sole source contract (Lewis et al., 2013).

Discussion of Source Post-award Performance

The relevant source post-award activities to this research are discussed in the DoD's *Diminishing Manufacturing Sources and Material Shortages* (DMSMS) guidebook (Defense Standardization Program Office, 2006). The DMSMS policy is established within Enclosure 6 of

DoD instruction 5000.02 and identified as an essential driver to reducing sole-source reliance issues within the DoD Inspector General's annual report titled *Top DoD Management Challenges – Fiscal year 2020* (Office of the Inspector General, 2019). In accordance with the DFARS and standard supply chain practice, contract performance milestones and post-award metrics are listed in the mutually agreed contract (Department of Defense, 2016). On-time product delivery and delivered product quality are among common metrics collected and reviewed periodically by the DoD contracting officers (Hamid et al., 2016). DoD contracting officers use these key performance indicators (KPIs) to determine whether the current qualified supplier, or set of multiple suppliers, needs to be assisted, incentivized, or replaced to improve the quality or the on-time delivery of the required product or service (Wilhite et al., 2014). A supplier's perceived production competence is driven significantly by its measured KPIs within a contract's performance period. The theory of trade-offs applies when DoD contracting officers weigh the options they should take. Not every effect on KPIs is supplier driven. Some of these effects involve raw material shortages, force majeure conditions such as unusually adverse weather or pandemics, or third-party caused incidents beyond the supplier's control, including government-directed shutdowns, which can significantly affect these metrics (Namdar et al., 2018). However, suppliers are evaluated in an R.B.V. manner based on how they mitigate these effects, contributing to the recovery of lost schedule and reduced product quality (Namdar et al., 2018). This level of supplier performance monitoring provides information for both the current and future contracts, or follow-on contracts, that the supplier is under consideration.

The two-colored arrows at the bottom of Figure 1 show how the discussed theories apply to the shift in sole-sourcing reliance risks based on the number of viable suppliers in a given industry. The number of those suppliers maintained as qualified suppliers can potentially replace

current suppliers who default on their awarded contracts. Those who were originally qualified by the source selection teams to produce a product or provide a service but were not awarded contracts will not simply stand by waiting for those first awarded contracts to default. They will actively pursue other revenue-generating contracts needed to stay in business. As a result, they may not have the same production capacity, resource availability, and, in many cases, the desire to pursue a subsequent contract award, and therefore no longer be qualified suppliers (Defense Standardization Program Office, 2006). There is also the potential for suppliers to compete with or supplement the incumbent contracted suppliers when their contract periods of performance expire and DoD contracting officers issue R.F.P.s for the next performance periods. Whether the incumbent suppliers performed well during the previous contract period or are reconsidering an extension of their current contracts, this incentivizes some of the competitive suppliers within the same industry to invest in competing to become one of the replacement suppliers. This is what the green arrow symbolizes in Figure 1.

Discussion of Relationships between Concepts

Each process concept shares a common objective of identifying production competence and hopefully encouraging its increase through more business opportunities within the DoD supply chain network. Utilizing the theory of trade-offs to determine the best suppliers or set of suppliers for contract performance directly affects the degree of sole-source reliance within each DoD contracting officer's authority. The common thread between these three process activities, relevant to the sole-sourcing reliance topic, was whether the DoD contracting officers enabled their contracts to be awarded competitively among multiple qualified sources. Moreover, if they had to be awarded as sole-source contracts based on the determination that only one qualified supplier could provide the necessary products or services (Li & Debo, 2009).

The source selection process flow shown in Figure 1 shows the shrinking number of suppliers that proceed down the production competence funnel. These suppliers are identified as industry participants by the source selection teams to being designated as viable R.F.P. recipients, and finally qualified or competent suppliers at the bottom. During the pre-solicitation activities, DoD contracting officers and the source selection teams can affect how large the production competence funnel begins at its apex by expanding the number of suppliers to include in their market research and sending RFI's to more suppliers (Imeri et al., 2015). These actions enable more suppliers to confirm whether their technical and production capabilities meet the requirements or decide whether to invest in improving their capabilities to become more competent if they foresee a long-term opportunity for production contracts with the DoD.

DoD contracting officers shrink the production competence number further by sending R.F.P. solicitations to suppliers interested in providing the requested products or services (Department of Defense, 2016). The source selection teams review submitted proposals and apply evaluation criteria tailored to their specific project's technical, quality, and schedule requirement trade-offs, identifying a subset of competent suppliers capable of producing and willing to provide the requested products or services (Imeri et al., 2015). This is demonstrated at the bottom of the process funnel in Figure 1. From the remaining subset, the DoD contracting officers prioritize their negotiations and select the best supplier or group of suppliers to award their respective contracts (Department of Defense, 2016).

Once the selected suppliers have been awarded contracts, the post-award performance process begins. These suppliers are given product delivery milestones, minimum performance requirements, and financial incentives for meeting or exceeding them. They must provide progress reports that include anticipated delivery dates and material shortages that increase the

risk of not meeting their delivery milestones or performance requirements (Defense Standardization Program Office, 2006). The risks have a much greater impact on the DoD operational readiness expectations if there are no other qualified suppliers capable of producing the necessary products or services (Lewis et al., 2013).

Summary of the Conceptual Framework

The researcher's purpose in constructing the conceptual framework in Figure 1 was to show the relationship between the source selection process flow and how the applicable business theories affect the production competence output of qualified suppliers. The conceptual framework demonstrates a contributory relationship to the degree of sole-sourcing reliance within the DoD contracting officer community. During the pre-solicitation activities, the source selection teams that delve deeper into their RBV-based market research and actively send more RFIs to potential suppliers will likely increase the number of viable suppliers to send R.F.P. solicitations (Department of Defense, 2016). The teams that communicate better with suppliers responding to the R.F.P. solicitations throughout the source evaluation and decision phase will likely increase the number of suppliers deemed qualified and competent to meet the project requirements (Department of Defense, 2016). By sharing the team's evaluations of their respective proposals, the DoD contracting officers enable motivated suppliers to adjust their proposals based on the project-developed source evaluation criteria and increase their possibilities of becoming a qualified supplier. One of the largest contributing factors to sole-source reliance is the number of suppliers designated as qualified sources for a given product or service (Lewis et al., 2013).

The post-award supplier performance phase of government contracting also contributes significantly to the increased risks and reliance on sole-sourcing (Lewis et al., 2013). As the

process flow in Figure 1 shows, the number of qualified suppliers is the primary factor in determining if an awarded contract is sole-sourced or if multiple qualified suppliers exist at the time of the award. As highlighted in Figure 1, even if only one supplier is awarded the full contract activity, the colored arrows show why maintaining the ability to replace a contracted supplier with another qualified supplier decreases the risks of sole-sourcing reliance.

Definition of Terms

Relevant terms deemed essential to understanding this research study are defined and provided as points of reference below:

Contracting Officer: Under 48 C.F.R § 1.602-1 (2019), contracting officers are the delegated authority to enter into, manage and terminate agreements on behalf of the U.S. government agency they represent (U.S. Government Publishing Office, 2019).

Diminishing Manufacturing Sources and Material Shortages (DMSMS): DMSMS issues are the losses or imminent losses of manufacturers or suppliers of important resources, including raw materials or other tangible or intangible products, including software. (U.S. Department of Defense, 2006).

Follow-up Contract: A follow-up contract is the non-competitive renewal of an original contract between two or more parties for additional production and delivery of the same goods or services. Contractual terms and conditions may be modified per mutual agreement of all parties, including delivery rates, shipment locations, and unit pricing (Beuve et al., 2019).

Functional Obsolescence: Functional obsolescence occurs when a necessary component, while still available commercially, no longer functions as required due to required changes made to its design (U.S. Department of Defense, 2006).

Operational Readiness: Within the scope of this research, operational readiness describes the capability of a military unit, such as a weapon system or critical equipment, to perform the functions for which it is designed (Department of Defense, 2016).

Prime Contractor: Prime contractors are those manufacturers or system integrators contracted to produce and deliver major systems directly to a U.S. government agency and often have a network of second-tier suppliers for necessary subsystems, assemblies, and components (48 C.F.R § 3.502-1, 2019). A significant number of sole-source manufacturers are not prime contractors; they are often second-tier suppliers or even further down the prime contractor's supply chain network (Lewis et al., 2013).

Sole-source Manufacturer: A sole-source manufacturer is the only supplier capable of producing an item, whether due to its production capabilities, patent protections or strict specification requirements (U.S. Department of Defense, 2019). Sole-sourcing is different from single-sourcing, which occurs when one supplier is selected among a group of suppliers equally capable of producing the requested item (Namdar et al., 2018).

Source Selection Team (SST): A source selection team is a group of individuals chosen by the contracting officer to assist in evaluating and selecting potential supplier sources for the specific acquisition (Department of Defense, 2016).

Assumptions, Limitations, Delimitations

Assumptions

The focus of this case study was on the experiences of the DoD contracting officers during the source selection and post-award contract performance processes. Because the researcher needed to narrow the case study by not expending significant time delving into the

credibility of each DoD contracting officer participant, the following two conditions were assumed to be true for this study.

Contracting officers were assumed to possess sufficient knowledge and experience regarding the government acquisition system, including the source selection process and post-award contract performance activities. Most DoD contracting officers are O-4 or higher career military officers or civilian employees who have attained the GS-1102 specialty classification through extensive training (Warren, 2014). As detailed in the Defense Acquisition Workforce Improvement Act of 1990, DoD contracting officers must meet specific education, experience, and training requirements (Rendon, 2015). They must also maintain their contracting skills proficiency through 40 hours of mandatory training every two years (U.S. General Services Administration, 2018). All participating contracting officers confirmed that they were certified and current on their required training during the time of this case study.

The second assumption was that the contracting officers would provide honest responses to all interview questions and not feel restricted in providing accurate and complete information about their experiences. This was to avoid any conflicts of interest or concerns about workplace retaliation for exposing sensitive issues that warrant discussion. DoD contracting officers are expected to practice the highest level of integrity, honesty, and objectivity in performing their duties (U.S. General Services Administration, 2018). Their years of government contracting experience have not only resulted in a high level of skill proficiency but also a high sense of duty and commitment to supporting the agency's best interests (Rendon, 2015). To further encourage honest and accurate responses, the researcher withheld study participants' personal identifiable information (PII) from publication and did not force interviewees to answer questions that made them uncomfortable.

Limitations

Employing the case study design presented two general challenges for the researcher. The first challenge was being sufficiently disciplined in researching to ensure methodical procedures were followed, not allowing anecdotal evidence to influence the interpretation findings (Yin, 2018). The second was not overly expanding the selection of potential cases such that sufficient resources to conduct the research became unavailable. The depth of understanding a case becomes too shallow, or the quantity of cases takes away from the focus of understanding being sought (Creswell & Poth, 2018). The ability to filter and bind the most relevant cases to be researched through tangible rationale is vital to conducting successful case study design research. This process also prevents vague information from distracting the researcher (Yin, 2018). The researched cases needed to inherently establish the sought-after common theme of the negative effects of sole-source reliance and validate the selection process for a good representative case study of the sole-source reliance issue.

Specific to the topic of sole-source reliance in the DoD supply chain network, contracting officers had limited availability to answer interview questions and discuss specific sole-sourcing situations. There were also limitations placed by the DoD leadership on which cases could be studied within the public domain, as opposed to internally, due to the potential exposure of national security issues. The researcher worked closely with DoD contracting officer management to identify enough cases to research the sole-sourcing reliance issue and with those the agency felt comfortable releasing relevant information.

Delimitations

The researcher needed to bind the potential pool of individuals to those who have experienced detrimental effects with sole-source contract arrangements. Those whose sole-

source reliance experiences did not result in significant issues were not interviewed. These DoD contracting officers were less likely to have considered alternatives or expressed any documented concerns. Circumstances exist when sole-sourcing can benefit a DoD program, and contracting officers have the discretion to decide when pursuing a sole-source agreement will be more useful than challenging (Warren, 2014). The experiences shared by the selected DoD contracting officers included at least one of these situations: 1) where a manufacturer started their DoD contract as a sole source; and 2) where multiple suppliers had qualified sources when the contract was awarded but over time became sole-sourced. Applicable to the first situation, the DoD has programs with distinct objectives, such as socioeconomic goals and long-term technical pursuits, which require its contracting officers to execute sole-source agreements from their inception (Hawkins et al., 2014). The first situation also occurs when a supplier submits a fully compliant proposal to a DoD contracting officer's request-for-proposal (Lewis et al., 2013). The DoD has dedicated one of the objectives of the DMSMS program to addressing the second situation (U.S. Department of Defense, 2006). These delimitations helped the researcher determine which conditions and activities during the source selection process contributed to the detrimental effects of sole-source reliance.

Significance of the Study

This study contributed to the supply chain literature regarding source selection processes and supply chain risk management practices designed to mitigate the impacts of sole-source reliance. This case study focused on the U.S. DoD contracting officer community. The sole-sourcing problem is also commonly experienced by commercial systems integrators and equipment manufacturers. Diminishing sources for critical supplies and the increasing reliance on sole-source suppliers are single points of failure for supply chain networks (U.S. Department

of Defense, 2019). The DoD Inspector General stated in his 2019 report that an increasing number of specialty manufacturers essential to the timely production of parts for DoD weapon systems have been unable to perform their awarded contracts. This has been occurring since 2010 due to budget cuts and continuing resolutions (U.S. Department of Defense, 2019). Due to the specialized nature of most DoD materials, many of the items that the DoD requires are provided through sole-source manufacturers, who often face issues with fulfilling the DoD's demand (U.S. Department of Defense, 2019).

Sole-source manufacturers are classified as single points of failure within the DoD supply chain network due to the DoD's inability to perform activities that rely on these suppliers' products if they cannot provide them (U.S. Department of Defense, 2019). There are many reasons, some unavoidable and others preventable, for the DoD to award contracts to sole-source manufacturers. Unavoidable justifications for awarding contracts to sole-source manufacturers include patented products that a supplier is unwilling to license, often from a competitor. Other justifications involve determinations through the source selection team's criteria review of supplier proposals that only one supplier meets the requirements to manufacture a requested product. Lastly, the lack of interest by other qualified suppliers to submit a competitive proposal for a product, referred to as a "no-bid decision," results in only one qualified supplier desiring the contract award (Department of Defense, 2016).

Reduction of Gaps

While many scholars have researched the effects of sole-sourcing within an organization's supply chain network (Lewis et al., 2013; Li & Debo, 2009; Namdar et al., 2018), identifying how organizations can reduce their reliance on sole-sourced commodities and components has yet to be well addressed. Much of the current literature about sole-sourcing was

focused on corporate manufacturers. It did not delve into the operational readiness effects on the DoD as described by the Inspector General (U.S. Department of Defense, 2019). Researchers discussing topics involving the DoD contracting officer and supply chain activities have primarily targeted process improvement (Hamid et al., 2016; Templin & Noffsinger, 1994) or procurement fraud (Rendon & Rendon, 2016). The existing body of literature did not address how DoD contracting officers had contributed to the increase in sole-source reliance within the DoD supply chain network. One objective of this case study was to research what guidance was available for DoD contracting officers to reduce the probability of DoD essential hardware, services, raw materials, and software from becoming reliant on sole-source manufacturers. This case study included examples of DoD contracting officers successfully reducing sole-source reliance and cases where other DoD contracting officers could not prevent a sole-source contract situation but were mitigating its effects.

Implications for Biblical Integration

Biblical inspiration for pursuing a topic intended to improve the performance of another professional community was influenced by Saint Paul as he addressed the Philippians. They were seeking to offer him material support for his ministry. Paul states, "Do nothing from selfish ambition or conceit, but in humility count others more significant than yourselves. Let each of you look not only to his own interests, but also to the interests of others" (English Standard Version Bible, 2001/2022, Philippians 2:3-4). Saint Paul advised that we must practice an empathetic approach when working with others and considering their needs and interests as much as, if not more than, ours. Selfish ambition can pollute our noble objectives in performing any activity with others, and it is for Christians to promote a biblical worldview to ensure that the interests and concerns of every participant are recognized and considered. The researcher

examined the prioritized interests of the DoD contracting officers as they went through the source selection process and identified how they may have contributed to increasing sole-source reliance issues within the agency through their programs and internal functional activities. While the identification of sole-source reliance as a problem may not be beneficial to some sole-source manufacturers who have recognized higher revenues and a steady production schedule within their organization. A higher level of DoD operational readiness can benefit far more, including American citizens and others worldwide who depend on the United States for their safety and security. A purposeful drive to further improve the world, especially in protecting this world, is highly evident in its practices, just as God's desire for all of us to be purpose driven. "And we know that for those who love God all things work together for good, for those who are called according to his purpose" (English Standard Version Bible, 2001/2022, Romans 8:28).

Relationship to Supply Chain Management

Reducing sole-source reliance was identified as one of the necessary activities within the DoD's top management challenges to improve its supply chain management practices (U.S. Department of Defense, 2019). Sole-sourcing reliance affects both the DoD and the suppliers within its supply chain network that depends on the performance of sole-source suppliers providing key components within a major weapons system, vehicle platform, or other complex equipment with multiple components. The inability of a sole-sourced manufacturer to provide necessary quantities of its components causes production schedule delays for the top-level system. It also causes reduced demands for the other components within the system as the inventories of those components are utilized at a lower rate due to the lower delivery rate of the sole-sourced components within the system (Mukherjee & Sarin, 2018). The reduced demand for the remaining components results in lower sales and revenues for every other component

producer within that system (Lewis et al., 2013). Major system integrators may be able to store larger quantities of components from the other manufacturers temporarily; however, inventory capacity can be quickly exhausted. Many of these components have limited shelf lives and warranty periods that begin from their initial delivery to the major system integrator, not the DoD end-user (Namdar et al., 2018).

Assessing which suppliers will make better partners within the DoD supply chain network can improve the performance of major system integrators. Furthermore, it can ensure that DoD requirements are met or exceeded in all elements of the DoD supply chain risk management practices and DMSMS program (U.S. Department of Defense, 2006). A robust supply chain risk management program needs to include the proper identification of possible supply chain risks, assessment of potential losses to the organization's supply chain network, and the coordinated application and monitoring of suitable strategies intended to reduce the impact of such loss events (Bak, 2018).

DoD supply chain risk management practices must focus on the issues created by increasing sole-source reliance, including potential losses if a sole-source manufacturer goes out of business or has a production mishap. Moreover, it can impact reductions in deliveries due to slowed production or product functionality deviations due to mandatory changes stemming from regulatory or environmental conditions (Namdar et al., 2018).

Summary of the Significance of the Study

Understanding the drivers that increase the agency's reliance on sole-source manufacturers and reducing the risks of DMSMS issues through the past experiences of the DoD contracting officer community can assist those engaged in the DoD source selection process. There is an opportunity to examine past cases and understand how many of the DoD standard

practices and processes may be inadvertently leading to increasing reliance on sole-source manufacturers. DoD contracting officers are placed in difficult positions to make decisions that affect more than their direct program authorities and are tasked with aggressive requirements by senior DoD administrators who also lack understanding of this issue. Researching issues through the DoD contracting officer perspective can also assist these high-level officials who are less likely to obtain this information directly from their contracting officers. These officers are primarily concerned with their scope of responsibility than the effects of their activities within the DoD supply chain network. The findings of this case study design research can hopefully lead to changes to current practices, revised expectations or policies, and encourage actions to address the issues communicated by the DoD contracting officers who participate.

A Review of the Professional and Academic Literature

The professional and academic literature review discussed supplier selection processes, sourcing strategies, and supply chain risk management procedures. After this foundational knowledge, the discussion progressed to how the U.S. Department of Defense (DoD) leadership has attempted to address this issue within its supply chain network, including differences between its approaches and the general business community. This review delved into the sole-sourcing reliance issue by identifying its negative effects on the general business community and specific impacts on programs and operations under DoD contracting officer management. The review's objective was to understand how the DoD contracting officers have been identifying and evaluating potential supply sources, whether subjective influencers, both foreseen and unforeseen, have weighed into their source selection decisions. Lastly, whether the risks of sole sourcing were sufficiently identified and mitigated before their source selection decisions. These decisions were compared to general business practices through an overview of supplier selection

and sourcing strategies and within the larger business landscape to identify specific sole-sourcing issues, including those preventable and those inevitable.

The first literature review section addressed the research progression of applicable supply chain management practices. The researcher then reviewed subsections concentrated discussions on supplier selection processes, sourcing strategies, and supply chain risk management procedures implemented throughout the general business community to identify consensus points within the academic field of study. Each subsection included the implementation of newer technologies to improve practices within these topics, such as supplier past performance analysis and supplier performance risk mitigation.

Following the broad academic discussion of these topics within the general business community, the second literature review section delved into processes and procedures traditionally implemented by the U.S. government within the supply chain management field. Specific to the study, the focus of this section was to identify any potential gaps between supply chain practices within the general business community and those that the DoD contracting officers exercise. The literature in this section included background information on DoD process implementations and recognized potential conditions preventing the full or partial applications of general business practices within the DoD.

The following section of this literature review identified the dominant performance and functional issues experienced by manufacturers that either originated or grew due to sole-source reliance conditions. This section first discussed the negative effects of sole sourcing suffered throughout the general business landscape and then presented specific impacts that DoD programs and operational units have faced historically and recently. The purpose of this section was to connect the foundational supply chain knowledge related to sole-source reliance with the

targeted focus of this subject within the DoD contracting officer community. This review led the researcher to formulate the final section of this review, the literature-based description of the potential themes and perceptions that were explored throughout the research.

Applicable Supply Chain Management Practices

In 2015, Wetzstein et al. completed their systematic assessment of the current academic literature on supplier selection and identified many important areas that scholars were directing their focus. Their study focused on methods, non-traditional selection criteria such as ecologically sustainable practices, strategic leaning, new product development-oriented, and operational themes within the supplier selection field. Much of the literature discussed in this review was identified through their work. The relevant literature in supply chain management practices formed the foundational knowledge for this research case study. Before discussing the specific sole-sourcing issues within the DoD contracting officer community, it was first important to understand some of the foundational supply chain management concepts that have been researched and improved over time. These include sustained competitive advantage, production competence, supplier selection processes, sourcing strategies, and supply chain risk management practices. Throughout the supply chain management field of study, there has been legitimate concern that much of the findings among academic research have not been translatable into actionable solutions or real-world applications (Liu & McKinnon, 2019).

Barney (1991) discussed sustained competitive advantage as a progressive objective that business organizations must pursue to efficiently allocate available tangible resources. The protection and best application of knowledge-based resources assist with understanding critical information such as potential barriers to entry and initial competitive advantages over others. Tangible criteria are much easier to compare and contrast, while intangible criteria are more

difficult to assess (Kawa & Koczkodaj, 2015). Tangible resources that are more available to the general public provide a higher competitive advantage for suppliers with access to them, as does the possession of more specific knowledge and technical information. The latter was more likely to contribute to the sustainability of competitive advantage (Hung, 2015). González-Benito (2007) asserted that purchasing roles within an organization (which are the principal functions of the DoD contracting officer within the agency) contribute significantly to an organization's sustained competitive advantage or, in the case of a nonprofit entity such as a government agency, its efficient and effective operation. Rowe et al. (2017) discussed how a business' product lifecycle management (P.L.M.), which spans through a product's initial conceptualization, layout, manufacture, distribution, retail sale, and eventual disposal, is being modified significantly when an industry is under consumer or regulatory demand. P.L.M. addresses recycling and other salvage recovery opportunities such as product repurposing.

Both Vickery (1991) and Szasz et al. (2015) provided important relationship insight between production competence and business performance within an organization. Vickery (1991) discussed the importance of understanding the relationship between an organization's production competence and its external environment, including its relationships within its target market and supply base and its preparedness to address controllable and uncontrollable environmental conditions. Szasz et al. (2015) performed a deeper analysis of production competence by grouping businesses into four competitive performance zones. The groups ranged from those who urgently needed to produce better than their competitors, those who could use improvement, those who had an appropriate production level, and those who were producing excessively. The authors found that those performing excessively while achieving production competence goals for one product may be wasting or underutilizing crucial resources, both

tangible and knowledge-based, that could be better used to raise the production competence of another business segment.

Supplier Selection Processes. Procurement agents and buyers must prioritize different criteria when pursuing a single-source arrangement over a multiple-source procurement to reduce the risks of the single-source contract developing a sole-source issue (Bevilacqua et al., 2006). When a source selection team plans to select only one supplier, technical support and product reliability need to be among the highest criteria evaluated (Bevilacqua et al., 2006). Xiao and Shi (2016) discussed how these shortages can create the need to implement a dual-channel supply chain with either Demand Channel Priority or Retail Channel Priority. This need generates a credible demand forecast, which can help determine the timing and amount of inventory replenishments most likely required with future products in the coming weeks (Brunaud et al., 2019). Applying the theory of trade-offs to prioritize the competitive criteria, the source selection team reviews each proposal from qualified suppliers and ranks them based on their measured value (Imeri et al., 2015). Measured values are calculated through a combination of factors developed by the source selection team, including a raw score for each factor and an agreed weight percentage (Wu et al., 2015).

There has been a growing demand over the past 10 years for more sustainably produced products. Manufacturers, especially those working on government contracts, have been incentivized through direct requirements or social consumer preferences to implement sourcing policies that encourage sustainable production criteria (Agrawal & Lee, 2019). Konys (2019) expanded the discussion on sustainable supplier selection criteria beyond sustainably competitive costs, schedules, and product quality results from a given supplier. The researcher delved into the heightened awareness of a business organization's environmental, economic, and social aspects

of forming relationships with critical suppliers. Lee et al. (2018) discussed improving supplier development within an organization through mentoring programs. The authors suggested sharing implicit knowledge to gain insight into a supplier's available resources (both tangible and knowledge-based), its current distribution capabilities, and specific improvement activities to raise the supplier's performance.

Some scholars have suggested that suppliers engaging with larger manufacturing firms should have special classifications regarding their successful training and adoption of Lean and Agile capabilities (Mokadem, 2017). Lean manufacturers have continuously examined internal processes to eliminate waste without sacrificing performance. Agile practices allow a business to respond to changing customer demands quicker and more efficiently with newer ideas and faster product development (Ghobakhloo & Azar, 2018). An argument has been made that a manufacturing firm's supply chain that has implemented either Lean, Agile, or both have improved its business competitiveness through more rapid adaptability to changing market demands (Mokadem, 2017).

Nair et al. (2015) examined the importance of ensuring that an organization's purchasing management be included in its supplier selection processes beyond the basic administrative roles that many corporations, including some aerospace and defense firms, have often limited them to perform. Beyond the purely technical requirements, pricing, and delivery schedule analysis of potential bidders, purchasing professionals understand many ancillary strategic factors that need to be considered. These factors include the internal time and costs of adding a new supplier into its databases or whether a proposed supplier has experienced difficulties with technical requirements or meeting product delivery schedules (Nair et al., 2015).

Sourcing Strategies. One of the essential functions of supply chain management is effectively and regularly evaluating its supply base's quality and delivery performance. Wu et al. (2015) proposed evaluating and selecting strategic suppliers for manufacturing firms by investigating strategic and operation criteria. The criteria would include financial performance indicators reported to Wall Street, the complexities of provided hardware and services, and their internal importance to a manufacturing firm's own processes. Wu et al. (2015) also discussed the internal process of deciding whether a product capable of being produced in-house should be outsourced, known as the make-buy decision.

Tayles and Drury (2001) discussed the make-buy decision process as a strategic comparison between the in-house manufacturing, which may include additional capital investment, versus the availability and affordability of outside suppliers. Mature industry businesses have successfully used make-buy sourcing strategies to expand their product lines by sharing some of their core activity requirements with well-performing suppliers to find opportunities for transactional cost improvement (Hayashi, 2008). Some have also structured their functional and production activities to be more modular and autonomous. This allowed for either rapid outsourcing of an internal activity or bringing an outsourced activity back in-house when unforeseen changes in market conditions, resource supply levels, or other global industry pressures occur (Park, 2018).

Sourcing strategies include single and multiple sourcing, backup supplier contracts, and spot purchasing when urgent (Namdar et al., 2018). Multi-sourcing can be an effective hedging strategy when the probability or the possible impact of disruptive risks is high (Ray & Jenamani, 2016). Dual-sourcing can be an opportunity to achieve better pricing when there are more than two potential suppliers through a two-stage process. This occurs when suppliers first compete to

be one of two finalists and then compete again for a more significant portion of the total procurement need (Alcalde & Dahm, 2019). Due to the expectation that procurement quantity would decrease when additional suppliers exist, other incentives should be added to the criteria, such as minimum-buy quantities and multi-period replenishment commitments offered (Tan & Alp, 2016). A multi-sourcing strategy can include a manufacturer utilizing a dual-channel supply chain that consists of both an online supply channel and a brick-and-mortar retail supply channel for placing replenishment orders (Xiao & Shi, 2016). Another alternative sourcing strategy, single sourcing with lot streaming, provides for the required material from a single supplier through two separate delivery arrangements. This can result in lower expected lead times and inventory levels (Mukherjee & Sarin, 2018).

Kumar et al. (2018) examined sourcing strategies where domestic and foreign suppliers were evaluated on the possibilities for disruptions in supply chain performance concerning the pricing opportunities commonly found in foreign contracting opportunities. They concluded that in a growing market, or one dependent on high reliability or lower operational downtimes, the pricing opportunities did not outweigh the higher value of a more stable supply chain delivery performance that domestic arrangements commonly provide (Kumar et al., 2018). Qi et al. (2015) discussed the greater importance of supplier reliability, even at higher wholesale prices for firms that depend on a higher degree of supply chain stability. Though there are potential opportunities for setting up dual-sourcing arrangements, there also exists a strategic need to ensure each supplier provides a minimum operational quantity, recognizing the higher profitability possible through the second source's performance (Kumar et al., 2018). Sawik (2018) identified the opportunity for higher demand fulfillment rates when both low-probability disruption and high-probability delay risks are aggressively mitigated. Conversely, overlooking

the probabilities of such risks during the supplier selection process can lead to delivery fluctuations and downstream production delays, which can be significantly detrimental in today's growing make-to-order and just-in-time production environments (Sawik, 2018). The inherent drive for suppliers to diversify their standard processes and product features must also be addressed within a sourcing strategy plan to ensure technical requirements. This plan is commonly referred to as "the form, fit, and function" of proposed components within a major system and does not negatively alter the overall system's performance (Tang & Kouvelis, 2011).

One of the most concerning commodities within the DoD supply chain network is electronics, including integrated circuitry, which is highly susceptible to adversarial attacks, counterfeiting, and simply lower quality throughput, especially commercially produced items (Jin & van Dijk, 2019). Semiconductor production has been outsourced significantly to high-risk countries, such as China, where all three production threats are highly prevalent, affecting profit margins within the general business community (Jin & van Dijk, 2019). For customers like the DoD that require their products to be highly reliable and more than affordable, these production threats can pose a significant danger to operational readiness and, subsequently, national security (Jin & van Dijk, 2019). In 2014, the DoD's sub-agency committed to its advanced technology research programs, known as the Defense Advanced Research Projects Agency (DARPA), proposed the Supply Chain Hardware Integrity for Electronics Defense (SHIELD) program to address several problems regarding electronic hardware. These solutions included: 1) recycled components sold as new; 2) unlicensed overproduction of authorized components; 3) test rejections and sub-standard components sold as fully qualified ones; and 4) electronic components marked with false reliability certifications or newer manufacture dates (Jin & van Dijk, 2019). One of the program's activities was having suppliers producing legitimate electronic

products add the insertion of an additional, ineradicable hardware item called a dielet. This hardware passively detects tampering or other malicious activity on a device or package; packages without a dielet are presumed to be unauthorized, as these tiny units are tracked by serial number and discarded by the DoD end-user receiving the electronic hardware (Jin & van Dijk, 2019).

Supply Chain Risk Management Procedures. Between 1995 to 1999, most journal articles in the field of supply chain management focused mainly on financial reporting and operations strategies (Tang & Nurmaya Musa, 2011). While a few more researchers were delving into this topic between then and 2003, supply chain risk management became a much more deliberated subject of academic study after 2003. The business management academic community began to pay more attention to how integrating risk management into supply chain policies and procedures was a more effective way to yield higher profits through more controllable internal practices (Tang & Nurmaya Musa, 2011). Hamdi et al. (2018) collected 124 journal articles between 2003 and 2014 that referenced supply chain risk management in relation to the supplier selection process. One of their key takeaways was that the earlier practice of supply chain risk management was primarily controlled by quantitative research. The techniques and the progression of these articles over time revealed the growing implementation of more qualitative methods due to the subjective nature of data, such as demand forecast becoming more subject to market randomness (Hamdi et al., 2018). Kumar and Park (2018) utilized five risk characteristics: reliability, responsiveness, flexibility, cost, and asset management efficiency, proposed throughout much of the literature reviewed to evaluate multiple risk management strategies and generate a set of correlations between them. Within a range of supply chain risk management strategies, Kumar and Park developed a framework for comparing different strategy

portfolios to determine how those strategies impacted supply chain visibility and proposed a method for determining how to quantify subjective impacts to supply chain risk visibility. This framework can assist with understanding the interactions and balances between various risk management strategies (Kumar & Park, 2018).

Bak (2018) identified four areas that he believed the most current literature publications were ignoring or undervaluing regarding supply chain risk management information. These included studies into the long-term benefits of implementing a supply chain risk management plan, a critical element of most program supply chain plans within the DoD contracting industry. One of the more important takeaways from this article was that most available supply chain risk management studies that focus on a certain region of the global economy rarely detail how those specific locations impacted a supply chain management organization's performance (Bak, 2018). Er Kara et al. (2020) identified the importance of employing effective data-mining techniques to accurately identify and sort the growing information overload of collected supply chain risk management data. This technique would prioritize those risks that are having the most impact within key industries and discover hidden risks through data correlations.

A significant portion of supply chain risks can be attributed to the increasing demand for manufacturers and logistics providers to decrease lead times and customize shipping practices. This change can expose them to greater uncertainties and reduced schedules to implement on-site security practices (Rodrigues et al., 2018). Assessing the varying requirements of different customers based on the diverse commodities being transported requires a combination of adaptive practices and decisions regarding whether certain potential customers should be left to others in the logistics industry (Lam & Dai, 2015). Ali et al. (2016) discussed how risk management within supply chain security is not limited to the physical safekeeping of assets.

The greater risks come from the threats to the intellectual property of critical components and designs, including how the integrity and safety of a product determine its proper performance.

Blackhurst et al. (2015) stated how both foreseeable and unforeseeable security risks could affect an organization's entire supply chain process and damage its reputation as a reliable provider of its products. Supply chain security has continued to be a growing academic subject within the supply chain risk management field of study, primarily due to the continuously improving connectivity between global marketplaces (Blackhurst et al., 2015). With that connectivity comes the increasing risks of both natural and artificial disruptions, which have significantly impacted the performance of many large and small firms (Ho et al., 2015). Lu and Koufteros (2019) cited recent supply chain disruptions that have inflicted social harm and injury, including the heist of a controlled warehouse containing large quantities of prescription drugs and concealed integration of cocaine smuggling within an organization's standard supply chain operations. Addressing risk elements within the logistics industry, Choi et al. (2016) discussed disruption risk management and different strategies that logistics firms could take to reduce their exposure and respond to both artificial and natural situations that threaten transportation and warehousing operations. Businesses that take these risks seriously are more likely to implement stronger security initiatives and build adequate safety stocks, which have reduced both the rates of preventable disruptions and the impacts of unpreventable ones (Park et al., 2016). For some firms, however, even as these risks are examined and quantified on an aggregate level for their management's review, it often takes additional measures such as government regulations and recurring inspections to facilitate their implementation (Lu et al., 2019).

The primary reason for researching supply chain risk management was to reveal opportunities to mitigate either the occurrences of negative impacts on a supply chain

organization, minimize the magnitude of those impacts, or both (Oliveira et al., 2019). With the advancement of information applications and the increasing amount of historical business data and statistics being analyzed, many organizations have expanded simulation models beyond pure scientific and technical applications to create predictive business models to strengthen forecasts and critical decisions. Oliveira et al. (2019) studied the contributions of simulation and optimization methods to the field of supply chain risk management, highlighting what they perceived as a significant gap between the effective utilization of these applications and the progressive alignment of different supply chain risks management phases. They also examined how the predictions of simulation and optimization tools such as scenario analysis and performance measuring systems like balanced scorecard approaches were being reviewed and evaluated by organizational management for potential implementation. While they found a substantial lack of utilization of these methods within the supply chain risk management field, the researchers also noted the consistently improved supply chain performance. Furthermore, the decision-making confidence within organizations that had implemented simulation and optimization methods into their standard operating procedures also improved (Oliveira et al., 2019).

Similarly, Parv et al. (2019) validated the effective use of optimization methods through Value Stream Mapping to employ lean strategies focused on detecting non-value-added activities and wasteful practices within a system and utilizing information tools for planning activities. Their case study within the automotive industry revealed opportunities identified through implementing simulation models for cost improvements and reduced waste that did not sacrifice important technical and quality requirements (Park, 2018). He et al. (2015) examined how simulation and optimization methods could be effectively employed to improve costs and

performance throughout the container supply chain network. This included container loading, storage, single-unit trucking transportation, pre-staging at large-scale facilities such as rail yards and shipping ports, intracontinental train transport, overseas cargo ship transport, and subsequent container receipt and unloading. An important finding in their study was the improper assumption that the container supply chain network performed significantly like most service logistics networks. Shipping organizations that had been more successful in dealing with disruptions and other realized risks were those that had utilized simulation applications to identify and perform hypothetical scenarios. These organizations trained their personnel in appropriate responses to mitigate potential effects when any of these became a reality (He et al., 2015). Ge et al. (2016) suggested simulation and optimization methods be applied within agricultural supply chains when overarching policy changes are being proposed as an effective virtual demonstration of the positive and negative potential effects. Many government officials are being lobbied to implement reactive legislation without objectively assessing their proposed policies. These predictive simulation models can provide a better analysis of which policies would address the demands to improve food safety and quality while maintaining or improving yield outputs and total operation costs (Ge et al., 2016).

Chappell and Peck (2006) introduced the possibility of utilizing Six-Sigma methodologies to lessen the probabilities and the effects of risk events within military supply chains. The authors employed the commonly used DMAIC process (Define, Measure, Analyze, Improve, and Control) and the associated set of quantitative and qualitative tools within each to identify important issues, their root causes, and potential solutions (Chappell & Peck, 2006). From these, the researchers generated an improvement plan of action that they believed should be implemented. However, most likely, it would not be due to conflicting interests among many

of the larger suppliers within the defense industry who benefit from many of these inefficiencies (Chappell & Peck, 2006). They assessed that the stability of defense industry stock prices and demand levels in the product categories most affected would need to become more causally linked to the proposed improvements. They can also be generated through any subsequent DoD-internal Six-Sigma applications before some of the improvement plans are widely accepted. However, they also suggested that opportunities such as these plans may provide for medium-size and small-size businesses seeking greater exposure within the defense agency (Chappell & Peck, 2006). The growing utilization of these businesses and others throughout many manufacturing industries was noted by Timans et al. (2017). They discussed how continuous improvement had become an industry requirement and a competitive discriminator for medium-size and small-size businesses that successfully implement Lean manufacturing and Six-Sigma practices.

Li and Zeng (2016) proposed an additional supplier selection method that utilizes one of the conventional analysis tools from Six-Sigma known as the Failures Modes and Effects Analysis, or FMEA. This process identifies the possible risk impacts of each proposed supplier relationship in a given supplier selection activity. As with most methods, source selection teams evaluate suppliers using a common multi-criteria framework; then, they examine potential deviations from each supplier's proposed performance as failure modes within the risk analysis (Li & Zeng, 2016).

Despite every effort taken to mitigate both the likelihood and the impact of risk events that threaten the successful completion of a contract's performance, there are circumstances, however, that require a contract to be terminated by either one of the contracting parties or through mutual consent (Ionas, 2016). The failure of at least one of the parties to meet its

contractual obligations is a common reason for rescission, as is a mutual agreement between all parties that the performance of the contract is no longer required or desired (Ionas, 2016). The occurrence of unforeseen and uncontrollable events can also require contracting parties to reassess whether the contractual performance can or should continue (Sârbu, 2016). Force majeure clauses are a part of most standard contract terms to protect contract participants from performance liability when natural or unavoidable disasters interrupt the contractual activity, such as by restricting at least one party from satisfying its obligations (Ezeldin & Abu Helw, 2018). In many cases, these events solely affect the schedule performance of a contract, and the contracting parties can and should, if possible, negotiate a revised schedule for the contract's successful performance completion (Sârbu, 2016). Force majeure is typically recognized as a justifiable cause for construction delays that entitles contractors to obtain time extensions but no monetary reimbursement for damages due to delays (Alshammari et al., 2017). Force majeure clauses have also protected suppliers to ensure that their delayed deliveries can still be received and paid when catastrophic events have forced production interruptions (Ezeldin & Abu Helw, 2018).

Government and DoD Supply Chain Management

The Department of Defense (DoD) maintains an elaborate and multi-tiered network of commercial business organizations known as the Defense Industrial Base. This network develops and delivers military systems and reliable high-technology components in response to national defense strategies and priorities. The United States Defense Industrial Base maintains its capabilities over other nations due to significant barriers to entry into this highly specialized supply chain network. This includes higher research and development costs, export controls on technical knowledge, and national security requirements (Dunne et al., 2007). Naturally, there

are strong correlations between the production of military and defense systems and the demand for them by the DoD and its foreign counterparts. However, there are different contributors to these relationships based on current geopolitical conditions and whether the demands for such systems are more economically-centered or security-based (Blum, 2019).

Corporate Social Responsibility (CSR) has steadily grown since its introduction into the academic business field in the early 1960s (Campbell et al., 2009). Large businesses have been pressed to engage in CSR in today's global-reaching, exceedingly litigious, and highly visible marketplace. Although these decisions can derive from noble intentions, they can satisfy consumer demands or contractual requirements (Flammer, 2018). Flammer (2018) examined how organizational management that practiced CSR before it became an expectation or when it was not a mandated requirement was more often able to negotiate larger, more complex contracts with the government and large businesses. These successful negotiations were based on a greater environment of trust between all contractual parties. CSR activities that displayed genuineness and greater internal employee participation were high-value discriminators for their business organizations in competitive source selections in which longer-term arrangements were being pursued by the government (Flammer, 2018). Promoting fair business practices, treating everyone involved in corporate activities equally, understanding how business operations impact communities and the environment, and looking for opportunities to be better community members are concepts that endear an organization to its local elected leaders. These leaders, in turn, encourage the government contracting community to reward these businesses with more favorable agreements (Flammer, 2018).

The discussion of government contracting, within which the DoD contracting community operates, determines how government contracting compares and contracts with general business

practices. This section of the review addresses other related U.S. government supply chain topics that provide additional insight into its approaches to issues and challenges in this field.

Gaps between General Business and DoD. Government contracting makes up roughly 10% of the U.S. gross domestic product each fiscal year. It is one of the government functions most prone to fraud, waste, abuse, and political corruption (Beuve et al., 2019). One would believe that government contracting would exhibit lower levels of these based on the public oversight of contractual activities and the expenditure of public funds. However, due to the intrinsic insertion of political interests and changing administration priorities in response to current issues being faced, the interpretations of work scope, acceptance criteria, and legal terms and conditions become more malleable (Beuve et al., 2019). Beuve et al. (2019) found a significantly greater amount of contractual rigidity clauses among government (public) contracting agreements than in their same sampling of contracts between solely private parties. This is attributed to the additional protections private parties need to hold government entities accountable to mutually agreed terms, provisions, schedules, and pricing arrangements, especially those extending beyond initial contracting authorities.

One of the largest industries participating in government contracting is the aerospace industry (U.S. Department of Defense, 2019). Soshkin (2016) provided a general overview of the aerospace industry and established its importance to the global economy, its customer base that influences it, and its product segments. The article dove deep into the statistics and general information about the aerospace industry and avoided any significant strategic recommendations beyond some generic predictions about the industry. Due to this case study being set within the DoD organization, it only seemed appropriate to research the potential application of Six-Sigma within a direct aerospace and defense application. This is the most common type of business

organization interacting with the DoD contracting officer community (Thomas et al., 2016). The utilization of Six Sigma DMAIC techniques to evaluate the maintenance and repair operations (MRO) facilities is even more relevant to this case study. Given its intersection of both aerospace industry expectations and its service-oriented activity focus, both of which the DoD sets through contractual or regulatory requirements.

The authors de Rassenfosse et al. (2019) discussed one field of contracting that is significantly different between the general business community and the U.S government. It includes a significant number of those under contract with the DoD; these are suppliers purely under contract for research and development (R&D) activities, which currently total over \$50 billion per year, with just over 50% of that issued by the DoD. One of the primary justifications for the U.S. government to issue such contracts is to secure either licensing or assignments of the patents generated under the scope of work for these contracts. Many of these cases reduce an anticipated reliance on a sole source that could potentially patent a product or enable technology through its funding. These suppliers can then command their own contractual conditions for pricing, production schedule, and even preferred design features (de Rassenfosse et al., 2019). Research and development stretch across all of the critical mission areas of the DoD and many of the sole-source contracts issued by the DoD each fiscal year are to major corporations and high-tech small businesses. These businesses have demonstrated specialized technical skills and capabilities through earlier R&D accomplishments but lack adequate funding, security protocols, or both to proceed to desired follow-on projects. The DoD controls access to enabling technologies through these contractual collaborations while encouraging domestic aerospace and defense firms to pursue further technological advancements (de Rassenfosse et al., 2019). While this arrangement benefits many small businesses, the DoD has historically struggled to meet its

congressionally mandated contracting percentages to small businesses, including directed demographic breakouts such as women-owned, minority-owned, and veteran-owned businesses (Schilling et al., 2017). Schilling et al. (2017) identified the prevalent perception among the DoD leadership, the contracting officer community, and even small businesses surveyed that the defense industry was challenging for businesses other than the large, more-experienced corporate entities. Their study revealed that while this was true in some select categories, this was not the case among most factors weighted within a typical DoD source selection (Schilling et al., 2017).

Stanford et al. (2016) discussed a contracting agreement type that has been growing in use within the DoD contracting officer community and other public sector relationships that those between private parties in the general business community rarely utilize - the indefinite-delivery–indefinite-quantity (IDIQ) contract. Unlike a traditional contract with defined pricing for a defined scope of work or product, the IDIQ contract allows for some contractual conditions and arrangements for products or services. This includes pricing, delivery schedules, and applicable terms and conditions to be negotiated and accepted before any funding obligations or commitments are made between the parties (Stanford et al., 2016). Also known as task-order contracting, this open-ended process permits a public entity like the DoD to enter into general agreements with a supplier or set of suppliers to procure goods or services over a multi-year period. This process must occur before firm requirements are issued and before funding authorizations are secured (Stanford & Molenaar, 2018). Most IDIQ sourcing strategies start with the general evaluation of a pool of qualified suppliers based on either historical pricing or a combination of technical qualifications and pricing. This sourcing strategy determines a pre-qualification of a sub-set of suppliers to secure either blanket purchase agreements or reach a consensus on general terms while waiting for finalizing technical requirements and funding to be

authorized. Once these occur, the government subsequently places hardware delivery orders or service task orders under the contractual agreements made under the IDIQ contracts (Stanford & Molenaar, 2018). IDIQ contracts include a set of contractual upper and lower limits that range in periods of performance from one to five years and allow a federal agency to quickly request and execute specific task orders from preselected suppliers that utilize prenegotiated terms, pricing, delivery schedules, and product specifications (Stanford et al., 2016)

Addressing some of the more prolific differences between supply chain practices in the general business community and those employed within the Department of Defense (DoD) assisted the development of an understanding of how DoD contracting officers perform their responsibilities. These officers are often limited in what methods and solutions are available to address issues such as sole-source reliance. A critical element to this is the frequency of changing political priorities within the U.S. government. This requires additional conditions to be placed on every prime contractor and sub-tier supplier that chooses to solicit, compete and, if selected, enter into a contractual relationship with one of the U.S. government agencies (Howard et al., 2016). The U.S. government is required by the U.S. Constitution (Article I, section 9, clause 7) to have its proposed budget submitted by the President and approved by Congress annually. Every government program goes through a reassessment of its importance to the current political landscape (Howard et al., 2016). Business organizations that regularly participate in the government contracting field must continuously address the possibility of having active contracts, including very long-term agreements, terminated for no other reason than the government's convenience to reallocate spending to other priorities.

DoD Process Implementations. Supplier selection criteria for most government programs, including those led by the DoD contracting officer community, often extend beyond

the simple and objective analysis of proposed or anticipated cost, schedule, and product quality from a given supplier (U.S. Government Publishing Office, 2019). Within the Federal Acquisition Regulations (FAR), Subpart 15.3 addresses how the U.S. government shall conduct its source selection process. This includes specific conditions listed under paragraph 15.304 when a contracting officer may decide to either elevate criteria other than cost or pricing or remove cost and pricing from the evaluation criteria altogether (U.S. Government Publishing Office, 2019). Criteria for this exception under paragraph 15.304 include supplier performance history, minimum compliance thresholds to solicitation requirements, documented technical expertise, corporate management performance, minimum personnel qualifications, and proposed staffing (U.S. Government Publishing Office, 2019).

Templin and Noffsinger (1994) provided an early in-depth analysis of how the DoD contracting officer community performed the source selection process and discussed many of the common evaluation factors still used in determining the preferred suppliers to negotiate defense contracts. In addition to discussing objective criteria such as competitive pricing and production schedules, the authors assessed how source selection team members need to evaluate more subjective factors such as anticipated technical performance and risk exposures based on past performance and government regulation compliance history (Templin & Noffsinger, 1994). They introduced four evaluation factors, including cost as the first criterion. They emphasized that, while it needs to be a significant factor, it should not be the dominant one for government contracting (Templin & Noffsinger, 1994). Performance criteria such as technical approaches, schedule logistics, and evidence that a potential supplier fully understood both the technical requirements and the government regulatory requirements should be given a higher prioritization. This is more important than competitive cost, as failures in any of these criteria

will most likely result in additional costs, both directly and indirectly, that will not be easily recoverable (Templin & Noffsinger, 1994).

One of the essential characteristics of understanding defense contracting and the priorities of the DoD contracting officer community is that the United States government is not a profit-generating organization (Wilhite et al., 2014). Wilhite et al. (2014) examined the supply chain network within the Army. While always seeking to effectuate cost savings and other business efficiencies, it must not lose focus on its priority of operational readiness and ensuring that the U.S. Army is the most powerful and effective military ground force in the world. The DoD contracting officers within the U.S. Army organization must successfully negotiate the timely and cost-effective procurement of complex weapons systems. They are often both scientifically innovative and very expensive to design and manufacture. The authors discussed the closed-loop supply chain networks used by the U.S. Army to respond to everything from wear-and-tear maintenance, equipment replacement, to the implementation of technological advancements that continue to provide the American warfighter the most military advantages on the battlefield (Wilhite et al., 2014). Tsadikovich et al. (2016) also reviewed the demand-responsive scheduling of maintenance and transportation operations necessary within the military supply chain. The authors focused on how in-depth analysis within it has improved most areas, including warehousing, production, repair and maintenance, and transportation.

While benchmarking the maturity of contracting processes within the U.S. Navy, Rendon (2015) revealed that the organization performed the pre-award contracting activities such as source evaluation and selection very well. The post-award contracting activities of supplier performance management, contract administration, and contract closeout had significant deficiencies. Limiting his assessment surveys to active and qualified Navy contracting officers,

the author sought out opportunities to improve the integrity, accountability, and transparency of the government contracting process (Rendon, 2015). In a follow-on publication, he co-authored a discussion about procurement fraud incidents within the Department of Defense (DoD). He identified the phases of the government contracting process within which these incidents occurred (Rendon & Rendon, 2016). Not discounting the likelihood and effects of incidents in the pre-award contracting activities, both authors identified a higher propensity for incidents during the post-award contracting activities. Internal monitoring practices tend to drop in frequency, and complacency in maintaining compliance with government regulations increases (Rendon & Rendon, 2016).

Within a highly transparent marketplace, where it is significantly easier to examine how a business interacts with its employees, its local community, and in political matters, consumers place more weight on the heuristics of an organization's supplier selection process (de Boer, 2017). Nowhere is this more prevalent than within the government contracting process, primarily due to the heavy influence of congressional committees. They demand that contractors, directly or through prime contractors, adhere to high CSR and business ethics standards, including strict labor regulations and preferences for socioeconomic programs through Federal Acquisition Regulation requirements (Department of Defense, 2016). Bove et al. (2017) examined how government expenditures compare and contrast during our political cycles, including similarities between spending practices within left-leaning and right-leaning administrations and their differences. In addition, they affirmed that left-leaning administrations tend to spend more on social programs while right-leaning administrations spend more as a percentage on defense and military. The authors revealed that both administrations tend to spend more on defense and military early in their terms and shift to prioritize social programs as the next election year

approaches (Bove et al., 2017). Yanovski and Zatskovetsky (2017) further added to the Bove et al. (2017) analysis of the significant concern regarding the lowering priority of national defense in left-leaning (democratic) states. The authors identified a correlation between the reduced military defense spending as a percentage of a nation's GDP and internal growth in the use of military justice over civilian representation. They identified the troubling transition of governing administrations from limited powers among the responsible citizenry to a larger, socialistic spread of controls among lesser educated, more institutionally corrupt individuals focused on authoritative sustainability rather than protecting all citizens (Yanovski & Zatskovetsky, 2017).

Within the U.S. government, the challenges of most major defense acquisition programs to meet projected costs, schedules, and performance parameters have resulted in numerous program reviews in front of congressional committees and panels (Witek, 2017). In his detailed research into the largest major defense acquisition program in history, the F-35 Joint Strike Fighter Program, Witek (2017) identified some of the acquisition strategy challenges facing such programs. These strategies include balancing requirements, harnessing technology, demanding commonality, evoking concurrency, and encouraging partnering. The author pointed out that these challenges are not mutually exclusive; difficulties experienced in one area can also affect others, requiring solutions that also improved multiple evaluation criteria. Witek (2017) suggested a strong correlation exists between balancing requirements and demanding commonality, and each requires significant technical design application and compliance with military standards. Also, a correlation between harnessing technology and evoking concurrency, newer technological performance and production line schedules must find common improvement opportunities (Witek, 2017).

Sole-Sourcing Reliance Issues

Sole-sourcing supplier relationships occur when one supplier becomes the only qualified provider of an essential product or commodity, either through contractual or business environmental conditions. This can increase supply chain risks such as single-point supply disruptions and reduced product design autonomy, including reduced opportunities to utilize technological advances in related product lines (Lewis et al., 2013). In earlier research, the discussion of sole-sourcing strategies had been broadly defined to include any contractual commitment by a customer or manufacturer to fulfill all current and future demand volume of a select product or commodity from one supplier among a field of multiple qualified suppliers. This subset, better described as single sourcing, does not generate the same detrimental reliance issues as sole-sourcing due to the contractual terms and conditions which allow for lawful contract terminations to prevent or significantly reduce such reliance (Li & Debo, 2009; Namdar et al., 2018).

Namdar et al. (2018) provided analysis regarding manufacturers benefiting from single-sourcing, which is the intentional selection of one supplier among a field of multiple qualified suppliers, including lower pricing for larger quantity orders, faster production quality yield improvements, and stronger customer-supplier relationships. The researchers, however, were careful to distinguish the single-sourced arrangement, in which other qualified suppliers existed among the source selection pool of suppliers. The arrangement with the selected supplier had not been contracted to eliminate the possibility of a multiple-source or source-replacement contract being negotiated in the future from the sole-sourced arrangement defined earlier (Namdar et al., 2018).

Chen (2016) evaluated four possible sourcing strategies. This included single-sourcing and dual-sourcing, in which the two selected suppliers decide whether they cooperate in making quality decisions. When the manufacturer is actively involved and invested in quality determinations, the single-source arrangement is the most productive; however, if not, both of the dual-sourcing arrangements proved to be (Chen, 2016). Among the two dual-sourcing strategies, it also proved to be more beneficial to keep each supplier separate while discussing quality decisions with the manufacturer to keep them unaware of the other supplier's discussions (Chen, 2016). When the suppliers were given the opportunity to collaborate on the quality level aside from the manufacturer, the product quality tended to be diminished (Chen, 2016).

Negative Effects in the Business Community. Lewis et al. (2013) addressed the challenges of sole-sourcing arrangements and some of their negative effects throughout the business community. They explained that while sole-sourcing relationships can yield some of the same benefits as single-sourcing, they must be closely monitored and funded throughout the top-level product life cycle to maintain those same benefits. Product design autonomy, including opportunities to utilize technological advances in related product lines, can be significantly reduced if not addressed early (Lewis et al., 2013). The bigger concern, however, for sole-source relationships is supply disruptions in which manufacturing customers and end-users such as the DoD are limited in their courses of action due to the potential negative effects likely to arise, either contractually or naturally.

The global economy has never been so interconnected, and manufacturers have never been so dependent on their supply base for their internal production activities (Hou & Sun, 2016). Due to the larger impact of the global economy on manufacturers, supply disruptions are far more diverse for most manufacturers than in the past (Hou & Sun, 2016). They can range

from labor shortages and energy blackouts to flu pandemics and regional terrorism (Hou & Sun, 2016). However, many businesses are not actively weighing such disruption risks as they design and manage their supply chain networks.

These strategies are not necessarily intended to boost profits when supply disruptions are non-existent or rarely occur. Demirel et al. (2018) examined the flexible sourcing strategy in which a manufacturer outsources its demand for a given component or set of components to more than one supplier based on an internal risk analysis of the competitive suppliers. In most of these cases, the less-competitive supplier was unwilling to price-match the more-competitive supplier, meaning that units provided by the second supplier were priced higher (Demirel et al., 2018). Also, because most suppliers in volume-unit production industries have minimum-buy requirements, opportunities for volume discounts for one combined production run were unavailable. The authors noted that this strategy was only beneficial in a high-risk supply disruptive environment when the negative effects of sole-sourcing arrangements were both probable and impactful if realized (Demirel et al., 2018).

Hsieh and Putera (2018) discussed some of the severe negative effects that sole-sourcing arrangements can have on the profitability and competitiveness of a manufacturer either directly or further up a multi-tiered supply chain. They mentioned some of the major natural disasters in recent history, such as the Japanese earthquake in 2011 that disrupted over 25% of the global supply of semiconductor wafers that chip producers such as Samsung, Sony, and others depend on for production. They also mentioned the March 2000 lightning bolt hitting a Phillips manufacturing facility in Albuquerque, New Mexico, causing damage to millions of chips heading to Nokia and Ericsson (Hsieh & Putera, 2018). The authors discussed the supply restoration process by which these manufacturers who entered into sole-sourced arrangements

based on pricing opportunities, larger delivery quantities, and consistent product quality had to secure alternative sources for critical components quickly. This included the lost production time to either assist or wait for the original supplier to bring their production back online or, if that supplier cannot do so in a reasonable time, quickly negotiate a new sourcing arrangement with an alternative supplier (Hsieh & Putera, 2018). They also debated the differences between mitigation (or preventative) strategies, such as dual sourcing, safety stock inventories, and contingency (or reactive) activities like the emergent rerouting or demand management described earlier (Hsieh & Putera, 2018).

Li et al. (2017) evaluated three similar strategies regarding supply disruptions by first setting up two different production systems. The systems were a single manufacturer with a sole-source supplier that ignored risk prevention and another that inserted idle time into each production step to prepare for potential disruption. For each of these, the authors evaluated how different types of supply disruptions could be potentially mitigated, what the effects on production run times were and how the cost of lost sales and other recovery costs affected the strategic decision-making process (Li et al., 2017). Three strategies were assessed in this study – the first was the basic passive acceptance assigned to the manufacturer that ignored any risk prevention and simply dealt with the supply shortages, waiting for the disrupted supply chain to work itself out. The other two strategies were divided into a reactive recovery scheduling strategy. The manufacturer responded to the disruption by seeking alternative sources while assisting the current supplier with recovery activities. A backup strategy is implemented where a manufacturer generates a higher level of safety stock within its inventories of critical components (Li et al., 2017). The researchers examined two hybrid strategies, the passive-backup strategy and the reactive-backup strategy, in which the common element was the backup

strategy. They concluded that the reactive-backup strategy was the most effective at mitigating the negative effects of the most common supplier disruptions (Li et al., 2017).

Specific Impacts to DoD Programs and Operational Units. Sole-sourced components and sub-assemblies are more likely to affect the timely downstream production of their parent assemblies, ranging from small electronics to high-tech machinery and multi-million dollar aircraft. Combined with scheduled maintenance and unscheduled repairs to those already in use, sole sourcing can significantly affect the operational readiness of many large-scale corporate and government organizations, including the U.S. DoD (U.S. Department of Defense, 2019). Sole-source manufacturers are classified as single points of failure within the DoD supply chain network due to the DoD's inability to perform activities that rely on these suppliers' products if they cannot provide them (U.S. Department of Defense, 2019).

Hague et al. (2015) addressed one of the primary concerns with sole-source suppliers within the DoD, the ability to maintain the continued availability of critical components over extended fiscal cycles. The authors identified the need to reexamine the selection criteria utilized in the source selection process and ensure that the capability of potential suppliers is verifiable (Hague et al., 2015). Furthermore, the research revealed the need to evaluate the weighing of such criteria based on the importance of such components to downstream production and maintaining operational readiness through their availability within the depot spares system (Hague et al., 2015).

Hutchison et al. (2016) identified some of the major challenges that the defense industrial base had been confronted with in recent years, including schedule delays, excessive cost overruns, and higher equipment failure yields. One of the highest contributing factors to these issues has been the decreasing number of system engineers employed throughout the defense

industry. Systems engineers are commonly tasked with providing the common vision and program management for complex defense systems that require other engineers of highly specialized technical disciplines to work together. This ensures they properly and thoroughly integrate every functional subsystem (Hutchison et al., 2016). They possess much of the critical knowledge necessary to understand customer needs and keep all the different disciplines focused on the overall system requirements. However, the increasing complexities in supply chain networks and operations have required systems engineers to become more proficient in non-engineering knowledge, including supply chain risk management and logistics operations (Hutchison et al., 2016).

Anticipated and Discovered Themes

The researcher identified anticipated themes from the literature review to aid the case study of the sole-sourcing reliance issue within the DoD contracting officer community. These anticipated themes were explored as study participants were initially surveyed and then interviewed to determine whether they could provide additional insight into how the problem statement could be addressed. From these, the researcher discovered which anticipated themes derived from the literature review were either substantiated or challenged through the experiences of the participating DoD contracting officers. This activity resulted in the set of discovered themes that are briefly discussed in this subsection. Following the presentation of findings, themes were developed and explained in the context of how they were generated.

Potential themes from the literature review included the evolution of the source selection process and the closely related impacts of supply chain risks that affect business manufacturing and its customers downstream in the value stream. From that evolution, emerging themes included:

1. Understanding how production competence determines the competitiveness and performance of suppliers.
2. Consideration of source selection criteria beyond competitive pricing.
3. The additional conditions the DoD contracting officer community and businesses soliciting for contracts under the United States Federal Government must address and comply.

In summarizing, it was important to establish the foundational themes of how the source selection process functions and then delve into what makes the sole-sourcing reliance issue within the DoD contracting officer community different than the general business community (Barney, 1991; González-Benito, 2007; Qi et al., 2015).

The first anticipated theme was understanding how production competence contributes significantly to how a supplier's capabilities are accurately forecasted (Szász et al., 2015; Vickery, 1991). As technology evolves and opens opportunities for businesses to compete globally, it remains imperative that suppliers understand what they can provide. This includes not only the technical capabilities of direct design and manufacture of a product but the coordination of both labor and material resources required. Furthermore, it includes the logistics of shipment and delivery of products when and where needed (Ali et al., 2016; Bak, 2018; Barney, 1991; Choi et al., 2016; Demirel et al., 2018; González-Benito, 2007; Ho et al., 2015; Rodrigues et al., 2018; Xiao & Shi, 2016). The literature review revealed how those suppliers who adopted earlier practices of incorporating supply chain management into their value stream addressed supply chain risk management more proactively than reactively and created competitive advantages that transcended simple pricing competitions (Bak, 2018; Chen, 2016; de Boer, 2017; Er Kara et al., 2020; Hamdi et al., 2018; Ho et al., 2015; Konys, 2019; Kumar et al., 2018; Lee et al., 2018; Nair et al., 2015; Szász et al., 2015).

The second anticipated theme from the review was the utilization of source selection criteria beyond simple competitive pricing to include many factors that contributed indirectly and often intrinsically toward the total cost of doing business with a selected supplier (Hague et al., 2015; Kawa & Koczkodaj, 2015; Konys, 2019; Mokadem, 2017; Mukherjee & Sarin, 2018; Wu et al., 2015; Xiao & Shi, 2016). The presented literature included multiple examples of manufacturers and product end-users who were challenged by both foreseeable and unforeseeable supplier disruptions. The researchers proposed multiple strategies for mitigating or potentially avoiding the risks of these through additional evaluation criteria during the source selection process (Demirel et al., 2018; Ge et al., 2016; Hou & Sun, 2016; Hsieh & Putera, 2018; Kumar et al., 2018; Lee, 2017; Nair et al., 2015; Namdar et al., 2018; Sawik, 2018). Within the source selection process, it is imperative that the evaluation criteria include as much useful information to address potential supply chain disruption risks as possible (Bak, 2018; Demirel et al., 2018; Er Kara et al., 2020; Ge et al., 2016; Hou & Sun, 2016; Hsieh & Putera, 2018; Kumar et al., 2018; Lee, 2017; Nair et al., 2015; Namdar et al., 2018; Sawik, 2018).

The third anticipated theme separated this study from most of the supply chain management research within the general business community. In addition to the normalizing effects of business practices and capitalistic approaches throughout the national and global economies, the DoD contracting officers and defense contractors have additional requirements. These requirements include regulations and hierarchies to contend with under the procedures for government contracts management within the United States federal government (U.S. Department of Defense, 2006). A significant portion of the literature review was dedicated to identifying the unique nature of supply chain management under federal contracts, including the Department of Defense (DoD), both regulatory and through understanding the importance of

every contract to one of the essential functions of government (Soshkin, 2016; Stanford et al., 2016; Bove et al., 2017; Yanovski & Zatskovetsky, 2017; Flammer, 2018; Stanford & Molenaar, 2018; Beuve et al., 2019; de Rassenfosse et al., 2019). The literature review revealed a significant deficiency in how DoD contracts have been negotiated to mitigate external supply chain disruptions, address supplier production competence diminishment, or technological advancement integration with the general business community. However, it must be in a manner that does not sacrifice national security or technical performance (Bove et al., 2017; Chappell & Peck, 2006; Dijk, 2019; Dunne et al., 2007; Rendon, 2015; Rendon & Rendon, 2016; Schilling et al., 2017; Soshkin, 2016; Templin & Noffsinger, 1994; Tsadikovich et al., 2016; Wilhite et al., 2014; Witek, 2017; U.S. Department of Defense, 2016, 2019).

While the themes that were discovered during the conducted research and interviews shared some alignment with the anticipated themes, some of these themes exposed root causes that the researcher did not anticipate regarding the sole-source reliance challenges facing the DoD and defense industry. More importantly, the research revealed some important subthemes within the more prevalent anticipated themes that should assist those researching this issue. During the analysis of the data, three thematic categories were identified – production competence, non-pricing factors in source selection, and additional conditions significantly more prevalent (or unique) to the DoD contracting community. Within the production competence category, the four sub-themes that were discovered were also discussed significantly throughout the reviewed literature. Er Kara et al. (2020) observed both a lack of proactive supplier risk management practices and a deficiency of supply chain management experience among industry program and project leaders, two of the emerging sub-themes of this research. The literature review also covered the issues of both finding interested suppliers and confirming their

capabilities to perform what is required in significant detail (Bevilacqua et al., 2006; de Boer, 2017; Nair et al., 2015; Namdar et al., 2018; Wu et al., 2015). However, the other two categories revealed some unanticipated themes from those covered in comprehensive detail within the literature identified within this academic field.

Within the non-pricing factors category, some of the DoD contracting officers participating in this study identified aggressive project schedules required to negotiate with potential suppliers as being a significant issue. Although not as many as those that identified the anticipated themes of dealing with patented products and non-negotiable government requirements to sole source suppliers for compliance. When the participants were asked about additional factors that they see the defense industry dealing with, the researcher discovered two themes that were not anticipated when conducting the pre-research literature review. While technological obsolescence with regard to parts or equipment was anticipated, the increasing non-defense industry applications of defense industry resources and the impacts of defense industry mergers and acquisitions were two of the more prevalent emerging themes that were not anticipated. The researcher discussed these themes in significant detail in Section 3, following the presentation of findings. As information about how defense equipment and capabilities became easier to research and test in the general marketplace, the demand for those materials rose significantly as well. Similarly, the supply base for key technologies and manufacturing capabilities became harder to secure due to key mergers and acquisitions that characterized the defense industry in the 1990s and early 2000s. The research process that validated much of the anticipated themes while delving into the emerging and discovered themes is discussed in greater detail throughout Section 3.

Summary of the Literature Review

A review of published literature, including professional and scholarly sources, was used to ground this research case study. Substantial attention was given to the topic of sole-sourcing reliance within the examination of scholarly and professional literature. In response to the primary research question, this literature review was conducted to determine the current research and the issues central to reviewing and understanding strategies U.S. DoD contracting officers utilized to reduce sole-sourced critical equipment components from their supply chain network. The purpose of this literature review was to discuss relevant journal articles and references that identify significant factors to sole-source reliance. Also, to break out this discussion into key topics and concepts surrounding the proposed case study and to demonstrate where the case study fits within the current body of research. Through this discussion, the researcher established a strong foundation from which to conduct the case study and identify opportunities for further research following the study.

Several themes from the current academic literature were relevant to this case study, and these themes formed the initial pillars upon which the case study research was collected and analyzed. This literature review was segmented into three primary thematic pillars that were integral to this study: a) applicable supply chain management practices, b) government and DoD supply chain management, and c) sole-sourcing reliance issues. This review was primarily focused on topics that supported the discussion about the inherent risks of sole-sourcing reliance within the U.S. DoD contracting profession (U.S. Department of Defense, 2019).

Transition and Summary of Section 1

Section 1 of this case study included the background of the increasing sole-source reliance problem within the DoD. The problem statement about heightened risks of operational

readiness reduction and manufacturing production delays. The purpose statement explored some U.S. Department of Defense (DoD) contract officers' strategies to reduce sole-sourced critical equipment components from the DoD supply chain. Lastly, the nature of the study was a case study design. Section 1 also contained the critical research questions, conceptual framework, definitions of terms, assumptions, limitations, delimitations, and significance of this case study. The researcher also provided the introduction and outline of the proposed professional and academic literature review.

This case study was conducted to discuss factors potentially contributing to the increasing sole-source reliance issues within the DoD contracting officer community. The next section presents the methodology and procedures that were utilized to conduct the case study, including the project design, research method, population sampling, data collection and analysis strategy, and reliability and validity of the case study.

Section 2: The Project

The Department of Defense (DoD) operational readiness relies heavily upon its ability to procure the hardware and services it needs to perform its missions. Even more important than affordability, the technical performance, high reliability, and on-time delivery of these items play a critical role. The incentives of suppliers to meet these high thresholds are significantly increased when there is great competition among the supply chain to provide these products. However, when the DoD creates a sole source reliance upon a supplier to offer its products, often due to patented technology or other favorable conditions contracted with the supplier, the incentives to provide such products on time and at an affordable price are reduced.

The researcher used the multiple holistic case study method to focus the research on DoD sole-source reliance within a selected set of critical hardware procurements where participants experienced significant issues or identified subsequent problems for the agency. This case study investigated the DoD source selection process and procedures and identified factors potentially contributing to the increasing sole-source reliance issues within the DoD contracting officer community. This section presented elements of the study, including its purpose, the role of the researcher, and the research participants. He discussed the flexible research design and the multiple holistic case study research methods, followed by the research population and sampling. The researcher then introduced the data collection process, including instruments, collection techniques, and organization techniques, followed by the data analysis and any coding process. This section concluded with a discussion about the reliability and validity of the study.

Purpose Statement

The purpose of this qualitative case study was to explore the strategies that some U.S. DoD contract officers used to reduce sole-sourced critical equipment components from the

supply chain. Early attempts to address sole sourcing include DMSMS programs implemented by larger manufacturers to identify components and materials at a higher risk. These programs can become either unavailable or significantly scarce to limit a product's manufacturability (DMSMS Guidebook, 2006). This study provided visibility into the engagement of DoD contract officers with the internal DMSMS program. Furthermore, the practice of flowing down requirements for such a program implementation to its prime contractors when contracting for the large-scale purchases of critical defense equipment, hardware, vehicles, and platforms. The findings of this case study offer increased awareness of proactively implementing such programs and explains some of the major DoD issues when no such program is required or when there is insufficient accountability for its proper implementation. Furthermore, the outcomes of this case study contribute to the literature on this topic by proposing recommendations for reducing the detrimental reliance on sole-sourcing by the DoD.

The researcher selected the multiple case study method to focus on the identified research problem. The next two sections discussed each part of the proposed case study research and how the researcher approached them. The role of the researcher is addressed first, including what actions were taken to perform the multiple case study research. Following this, the research methodology section addresses the appropriateness of the selected research design and method.

Role of the Researcher

Researchers need to go beyond traditional data collection, information gathering, and statistical analysis when conducting qualitative case studies. They must explore selected case studies with the expectation of receiving biased perspectives and limiting perceptions from their participants. The researcher for this case study also participated in the DoD contracting industry as an aerospace and defense supply chain professional. He had to ensure that his own bias

regarding how government contracting is performed did not skew either the data collection methods for this research or the subsequent review and analysis of the collected data. Business researchers who are commonly used to researching objective phenomena need to shift their focus when investigating case studies regarding business practices that involve subjective interactions such as contract negotiations or other human relations interactions (Rashid et al., 2019). This section delved into the researcher's role, and the techniques employed to minimize and eliminate professional or personal bias from the anticipated research.

The researcher's role in this qualitative case study was significant because the investigator served as both the primary instrument for data collection and as a government contracts subject matter expert. The researcher determines which participant perspectives are most useful in providing the necessary insight into the explored phenomenon (Creswell & Poth, 2018). The researcher held multiple recognized certifications in government contracts management and had been practicing in the contracts management field for over 20 years. He was directly involved with the DoD as a naval officer or a defense contractor for over 30 years. This provided the researcher with an experience-related analytical tool for categorizing data without the requirement of a past or current professional relationship between the researcher and research participants (Creswell, 2014).

The research data collection plan included the researcher, a member in good standing with the AIAA (American Institute of Aeronautics and Astronautics), securing permission to petition other members who were current or former DoD contracting officers. Furthermore, this study sought their assistance in reaching out to others who would be willing to discuss the sole source reliance issue as they have experienced it, being careful not to discuss any DoD sensitive or classified information. As Yin (2018) recommended, the researcher recruited enough

participants, obtained consent, conducted a survey, interviewed selected participants, analyzed and categorized the collected data, and identified key themes and correlations through interpreted findings.

However, it was critical for the researcher to ensure that his professional experience did not overly influence the pursuit of relevant data, such as questioning its objectivity or the derived findings. The researcher implemented a sufficient degree of bracketing, in which he set aside certain presumptions and previous understanding about the research topic to allow the phenomena and findings to be revealed and logically explained without prejudice or bias (Gregory, 2019). One of the ways that the researcher employed such bracketing was by selecting cases within the DoD in which he had no personal experience or previous insight beyond public knowledge. This included any cases where the researcher knew a participant through past professional working relationships or any personal networking associations. The researcher mitigated some of the bias by selecting participants from those currently or formerly employed in the proposed study's target participant role, namely the DoD contracting officers. The researcher ensured that his professional experience in the aerospace industry was different from that of selected participants in this case study research. The research presented new perspectives to the researcher about sole sourcing reliance within the DoD, reducing the impact of topical prejudgments and suggestive leanings from the researcher's professional past.

Research Methodology

This study was conducted with a flexible design using qualitative methods; specifically, a multiple holistic case study design was used. This research focused on how sole sourcing within DoD critical hardware procurements has resulted in late deliveries, longer operational downtimes, or shorter product utilization periods. These factors have decreased operational

readiness (Office of the Inspector General, 2019). The subsections that follow discuss the appropriateness of selecting a flexible design approach and the multiple holistic case study design method for this study. Moreover, the researcher highlighted the importance of incorporating triangulation of other research methods to improve the data analysis of this research data.

Discussion of Flexible Design

The flexible research design was selected because the specific business problem researched needed to be examined deeply through personal experiences. The researcher chose qualitative assessments of DoD contracting officers over quantitative empirical data such as contractual budget spending or other objective performance metrics. The research study was structured to solicit information from the participants based primarily on their subjective understanding of the situations they faced. It required the researcher to adjust his research collection, categorization, and analysis methods based on initial findings (Creswell, 2014). Under the alternative fixed design approach, the ability to adjust or supplement the research methods and tools is not available to the researcher due to the requirement that findings derive from objective, uniformly applied methods (Antwi & Hamza, 2015). Flexible design permits a less restrictive approach to investigating initial observations and potential narratives by allowing the researcher to use whichever research tools he saw fit as the research progresses (Ahmad et al., 2019). This research approach was more appropriate as the researcher discussed the sole sourcing reliance topic with interview participants.

Discussion of Multiple Holistic Case Study Design Method

Within the flexible research method, the case study qualitative design approach enabled the researcher to better explore how or why the issue of sole-source reliance existed through the

real-life experiences of the selected participants (Creswell & Poth, 2018). The primary objective of a case study is to concentrate research of a selected phenomenon on a specific case experienced by a tightly bounded set of participants, such as an individual, small group, or well-defined community. The existing research problem, sole-sourcing reliance, was clearly bounded, distinct, and described in appropriate detail within the parameters of government contracts management (U.S. Department of Defense, 2019). Additionally, the participant community, U.S. DoD contracting officers, was also well-defined (Yin, 2018).

For a proper case study design approach, the cases must be free flowing such that the researcher has little or no control over each case's events so that the research concentration can be on the cases themselves (Yin, 2018). This research was bound solely within the U.S. DoD contracting officer community, and the researcher had no control or influence in the growth of the sole-sourcing reliance issue. The case study research design was the proper approach for this research. This study combined common issues created through sole-sourcing reliance by the DoD contracting officer community and how their experiences contributed to understanding these common issues. Due to the context of the research question, the case study design was the approach selected (Yin, 2018). This study focused on a modern-day series of events that the researcher had little or no control over its occurrence, and the concentration of the research was on the cases resulting from those events. This approach highlights the case study design (Creswell & Poth, 2018).

Yin (2018) describes four types of case study design: single-holistic, single-embedded, multiple-holistic, and multiple-embedded. The researcher's determination of which case study was most appropriate began by considering whether a single case would be sufficient to present the sole source reliance phenomenon. In comparison, a multiple case study approach would

better validate the concerns about this issue. The multiple case study approach is more appropriate when the researcher attempts to identify patterns through replication of findings across multiple cases or when the researcher intends to compare findings across multiple cases (Yin, 2018). The researcher intended to establish the issue of sole source reliance within the DoD, having numerous cases aided in revealing this.

Choosing between a holistic case study design and an embedded case study design led the researcher to determine whether the case study was being shaped primarily by narrative or phenomenological bases characteristic of the holistic design. The researcher's plan to focus on the narrative case study research exemplifying the holistic design approach was more appropriate for this case study research. Yin (2018) discussed that an embedded study is more appropriate when additional empirical analysis is presented to the main case narrative. The researcher did not introduce any empirical or pragmatic analysis to this case study, and the multiple holistic case study design was the most appropriate for this research.

Discussion of Methods for Triangulation

To improve the validity and reliability of relevant information collected by research study participants, the researcher applied a triangulation methods strategy that implemented additional tools from other research methods where appropriate. While many researchers discuss utilizing triangulation in mixed methods research, using triangulation when conducting flexible method research in case studies is appropriate and useful (Farquhar et al., 2020). Before conducting a case study on the sole source reliance topic, the researcher implemented a preliminary survey among DoD contracting officers to identify and target a small subset with the most relevant experiences that could provide the most applicable information. The limitation of those participating in the survey to DoD contracting officers who have sole sourcing experience within

their current or former prime contracts was a form of data source triangulation. This proved valuable in identifying a highly applicable case study more efficiently and effectively than surveying an overly broad sample (Moon, 2019).

Summary of Research Methodology

The researcher conducted this research study utilizing a flexible design case study approach and applying a multiple holistic case study design method. Due to this research being concentrated on the experiences of DoD contracting officers, the researcher implemented sole-sourcing contracts within critical hardware procurements. The flexible design approach was most appropriate for conveying those experiences. The multiple holistic case study design method allowed the researcher to examine which negative effects from sole sourcing reliance were more prevalent than others based on their replication and presented these from a more narrative, phenomenological perspective. The researcher also identified opportunities to integrate triangulation methods within the case study design approach that improved the collection and analysis of relevant research data.

Participants

The research participants for this case study were current or former DoD contracting officers who had experience with the research problem, sole sourcing reliance within the agency. Specifically, the researcher identified candidates who represented the DoD in significant prime contracts where the DoD outsourced a significant portion of its critical hardware requirements to a sole-source supplier. As a result, these participants experienced one or more of the issues the DoD Inspector General discussed in its 2020 report (Office of the Inspector General, 2019). The purpose of this case study was to explore the strategies that some US DoD contract officers used to reduce sole-sourced critical equipment components from the supply chain. The participants

eligible for this case study were those current or former DoD contracting officers who were required to procure critical items through sole-source suppliers. This decision was made to understand the participants' actions and strategies to reduce risks to operational readiness.

Before moving forward with participant solicitation, including reaching out to the administrators of two identified professional organizations, the researcher obtained Liberty University's Institutional Review Board (IRB) approval to ensure his approach to this process met all ethical and academic protocols. The IRB's review included verification that the researcher was taking the necessary steps to ensure the rights of the anticipated research subjects were protected. Among these, the researcher agreed to maintain the confidentiality of the participants, including interview responses, and to minimize any personal identifying information (PII) or information considered either proprietary or confidential by the DoD.

Once the participants were properly identified, the researcher provided each prospective participant with a summarized message discussing the research problem and then offered to conduct a brief introductory telephone call with each participant. This allowed the participants to ask questions about the process and clarify expectations. It also allowed the researcher to address any privacy concerns. Candidates were allowed to decline participation if they did not feel comfortable participating or identified any additional accommodations they required. Most importantly, it allowed the researcher to express his sincere appreciation for their participation.

Population and Sampling

This section described the characteristics of the eligible population and defined how the participant sample was drawn for this holistic multiple case study. It then discusses the appropriateness of using the purposeful sampling method to construct the sampling frame, defends the eligibility criteria for the desired sample, and explains why it is appropriate for this

research method. The section also explains the preference for the anticipated small sample size of proposed participants, including why the small sample size provided sufficient saturation. It concludes by describing how the researcher gained access to the sample.

Discussion of Population

The initial population for consideration in this research study had to be distinguished from the final population sample, including those who met the participation criteria of either a current or former DoD contracting officer. These officers represented the agency in outsourcing critical hardware requirements to a sole-source supplier or experienced one or more issues because of sole sourcing reliance. The initial population included over 30,000 defense contracting professionals currently or formerly employed by the DoD's Defense Pricing and Contracts (DPC) department (Department of Defense, 2021). This group could have potentially totaled over 50,000 industry professionals among the membership of the professional networking organizations that the researcher intended to solicit participation. The solicitation request specifically asked for voluntary participation from members of these organizations who met the participation criteria described above. The researcher expected a response rate much lower than the eligible 30,000+ population based primarily on the outreach methods proposed to identify eligible cases. The researcher planned to narrow the eligible cases to those with significant impact and releasable information that did not compromise national security, an important priority and concern for the researcher. The next section discusses how the researcher reduced the eligible population down to a low sample size, anticipated to be less than a dozen solicitation respondents. Two or three cases met the criteria of being significantly impactful and were selected for further research and discussion.

Discussion of Sampling

For this qualitative case study involving the DoD contracting officer population, the focus of the sampling strategy was on finding a representative sampling of DoD contracting officers that had experienced issues from sole source reliance. Moreover, these officers had to be willing to discuss their experiences. To accomplish this, the researcher implemented a purposeful sampling method to select one or more contracting officers from a subset of those available and interested in discussing their government contracting experiences. The participants discussed how reliance on sole sources affected their contractual performance. When utilizing a purposeful sampling method, a researcher sought to obtain specific types of cases that were fundamental to the purpose of the study but would likely be unobtainable through random sampling methods (Krause, 2016). While random sampling methods enable unbiased quantitative inquiry and may be beneficial for identifying statistical trends, purposeful sampling pulls targeted information from a well-defined and controlled set of participants to gain an in-depth understanding of empirical generalizations (Emmel, 2013).

The sample was developed through a direct DoD information request to the DPC, and through membership within two professional networking organizations, the American Institute of Aeronautics and Astronautics (AIAA) and the National Contract Management Association (NCMA). Both organizations of which the researcher was a member in good standing, he was able to submit a request for members interested in being participants. The AIAA is one of the largest aerospace and defense societies in the world, and the NCMA is the largest professional organization dedicated to government contracting professionals. As a current member of both, the researcher utilized the membership message boards to solicit participation from AIAA and NCMA members. They were either current or recently retired DoD contracting officers.

Preliminary informal research identified group message boards as a good resource for requesting participation from those with specific contract management experiences. Each organization included many of those specializing in some of the key support functions within the aerospace and defense industry, including quality control, finance, supply chain, and contracts management from both the government and private business sectors (American Institute of Aeronautics and Astronautics, 2020; National Contract Management Association, 2021).

The desired sample was obtained from a very small subset of candidates that responded to a solicitation request. These candidates represented the DoD in significant prime contracts where it outsourced a significant portion of its critical hardware requirements to a sole-source supplier. They also experienced one or more of the issues discussed by the DoD Inspector General in its 2020 report (Office of the Inspector General, 2019). To try to set the proper expectations, the researcher conducted a LinkedIn search for his connections who were both contracting officers and were employed by the DoD. The result was "about 2,100 members" sharing some connection degree, with 180 members sharing either a direct "1st level" connection with the researcher or a "2nd level" connection. Therefore, the contracting officer and the researcher shared a common direct connection. The researcher then confirmed through approval of each organization's social media management authority that he was able to post a survey response request within the message boards and LinkedIn boards of the two networking organizations. Most of the 2,100 contracting officers within that network were able to see it in their news feeds. Based on average percentages of online survey respondents ranging between 15% and 20%, the researcher expected to see a survey response between about 300 to 420. However, only if the proposed survey included the ability for survey participants to have negative reactions to criteria questions (Pedersen & Nielsen, 2016). If the survey responses were

further reduced to only include positive responses to the DoD sole source reliance issue, the researcher expected to identify roughly 60 to 140 positive responses based on the DoD's current assessment of an 80% operational readiness (Department of Defense, 2021).

In August 2021, after securing the proper permissions and guidance from the respective administrators of each organization's social media management, the survey response requests were posted on the open forum message boards of both the AIAA and NCMA. The message board postings were clear that the proposed interviews would not include discussions of any DoD sensitive or classified information. Furthermore, there would be a request for assistance with reaching out to others who may not frequent the organization's message boards but might be willing to discuss the sole source reliance issue as they have experienced it. While the message board statistics showed hundreds of members viewed the recruitment request posting, only 36 individuals requested the survey. Eight of those individuals completed the survey and submitted it for consideration. Most of the remaining survey requests had no follow-up replies. Three survey requests stated they did not anticipate having sufficient time due to their workloads during the time of year the interviews were being requested, namely, September and October. From this subset of anticipated positive responses, the researcher confirmed that all eight respondents met the desired interview criteria. These individuals felt a significant impact from sole source reliance issues that were easily identifiable, releasable to the public, and could best highlight both the need and potential opportunities for the current DoD leadership to address the problem of sole source reliance within the DoD.

The final sample size for this case study was determined primarily by how many DoD contracting officers were either direct AIAA members or connected to the organization indirectly through working or personal relationships. Members forwarded the proposed survey to

contracting officers they knew. Saturation of the survey request within the population sample was the best method for determining the appropriate sample size. Malterud et al. (2016) suggested that an adequate final sample size be determined by the amount of relevant information returned by a targeted subset of participants within the sample. Hence, the researcher implemented the purposeful sampling technique. The three authors recommended a smaller sample size when the purpose of the study was narrowly focused and the participant interactions were highly detailed (Malterud et al., 2016). Based on this approach, the researcher believed completing interviews with the eight survey respondents would yield saturation.

Summary of Population and Sampling

The research was performed through the holistic multiple case study method; the number of desired participants that became part of the final sample size was very low. The researcher anticipated that two or three relevant cases would suffice to establish the significance of the problem statement. Also, each participant's experience did not have to be current or ongoing. As long as their case was fresh enough to have affected recent operational readiness within the DoD, it would be relevant to the research problem. The researcher utilized a small set of questions in his solicitation request for respondents to confirm that they would be suitable candidates to become participants. As recommended by Yin (2018), the researcher recruited enough participants, confirmed their informed consent, conducted a survey, interviewed selected participants, and analyzed and categorized the collected data from both the survey and interviews. The researcher identified key themes and correlations through interpreted findings. Since the researcher was successful in securing eight participants with the requisite sole-source reliance experience, saturation was able to be reached.

Data Collection & Organization

This section presents the data collection plan for this research study based on those elements necessary for the subsequent data analysis for the anticipated multiple case study design approach. It included a brief discussion of participant interviews and follow-ups, the proposed data collection instruments, interview guides and surveys, and the data organization plan. The appropriateness of the data collection approach included research questions, follow-up interviews, and whether existing surveys provide any additional reliability or validity. The section summary connected this to the resultant data organization plan and provided the segue to data analysis.

Data Collection Plan

This multiple case study research collected data on the sole sourcing reliance issues experienced by DoD contracting officers through open-source information, DoD statistics, and non-proprietary one-on-one participant interviews between the researcher and identified participants. In comparison, Yin (2018) described interview-based information as the richest form of data collection based on both the amount of information obtained from an individual and the ability to identify new follow-up opportunities. It was recommended by Creswell and Poth (2018) that early topical research through open-source investigative inquiries and other sources be conducted to improve the researcher's credibility from the perspective of the interview participants. Creswell (2014) also asserted that interviewing the subjects within a case study was one of the most appropriate data collection instruments to increase the reliability and validity of information collected in the more generic methods of online research. These subjects were often able to contribute subjective context to collected data and occasionally correct it.

Some of the interviews felt more characteristic of a follow-up interview because the information was collected before the interviews. The primary purpose of the interview questions was to address the research questions and strengthen or adjust preliminary inferences made from initial data collection. If there were any proposed follow-up questions arising from initial interview responses, the researcher ensured that they addressed the research questions and clarified or strengthened the connection to them. To do otherwise would have placed the researcher at risk of experiencing excessive scope creep, where an interview strays too far away from the purpose of the research (Creswell & Poth, 2018).

Instruments

This qualitative case study contained two primary research questions, with four sub-questions proposed to shed light on the topic of sole source reliance within the DoD contracting officer community. The researcher interviewed former and current DoD contracting officers who made sole-sourcing decisions and then faced issues stemming from those decisions. The two primary research questions were focused on identifying what strategies U.S. DoD contract officers currently use or recently used to reduce sole-sourced critical equipment components from the supply chain. Moreover, to recognize some of the tradeoff effects of significantly reducing sole sourcing within the U.S. DoD supply chain. The first objective was to establish the current state that has led to the detrimental results from sole sourcing and its identification as one of the DoD's top management challenges in the fiscal year 2020 (Office of the Inspector General, 2019). The importance of this foundation establishment was why four research sub-questions were developed. Most of the proposed interview questions were subsequently derived from these four sub-questions.

The interview questions were structured to determine how DoD contracting officers identified and evaluated potential supply sources within the selected cases. Also, whether subjective influencers weighed into some of their source selection decisions and if potential threats of sole sourcing were identified and mitigated before their source selection decisions. The researcher also considered the utilization of a preliminary survey. However, he concluded that due to the nature of this case study, the broadness of conducting such a survey with the amount of participation necessary to establish a sufficient level of reliability and validity would not have been appropriate. The interview guide utilized for the research study is included in the appendices (see Appendix A), and a brief discussion of each question follows.

The interview questions were intentionally open-ended to gain greater clarity into the primary research questions and the four research sub-questions. Once the researcher confirmed that responses to demographical questions verify that each candidate has the requisite DoD contracting officer experience with sole sourcing, he went through each of the seven proposed interview questions. The researcher highlighted the circumstances of each respective case.

The first five interview questions dealt specifically with the assigned programs of the participant contracting officers. The last two questions gave the contracting officer the opportunity to discuss their perspective of the agency's sole sourcing reduction and mitigation efforts on a broader scale.

The first two interview questions were tied to the first research question (RQ1a) about the proactive identification of sole-sourced components or subsystems. The first interview question (IQ1) asked the contracting officer whether there were any subsystems or components initially identified as sole-sourced due to unavoidable conditions. The second question (IQ2) focused on the time period after the contracting officer's programs were started and whether there were any

proactive measures taken to identify sole source risks so that mitigation steps could have been taken as early as possible.

The next three questions addressed a contracting officer's engagement with its first-tier suppliers on the sole sourcing reliance issue from initial requests for proposals to final product deliveries. The third interview question (IQ3) was structured to ask the contracting officers to delve more into how they were able to address sole sourcing reliance risks through contractor proposal requirements, a direct flow-down of the second research question (RQ1b). The fourth interview question (IQ4) was a natural follow-up to this topic by asking the contracting officer whether any mitigation activities were effective in reducing sole source reliance within their assigned programs. The next research question (RQ1c) was directly addressed by the following interview question (IQ5) by asking the participant contracting officer how sole sourcing conditions affected their program deliveries. This question also addressed the agency's operational readiness forecasts based on the projected schedule of those deliveries.

The remaining two interview questions shifted the focus of the sole sourcing reliance questions to allow the interviewees to give some of their perspectives on how the overall DoD strategies in this area either empowered or inhibited their own program's performance. These two interview questions were reformatted from the final two research questions, RQ1d and RQ2, to allow the contracting officers to address each topic. This was concerning their assigned programs rather than simply speculating on the DoD as a whole. Their responses provided useful insight into how the agency has been addressing this issue across the organization. Specifically, IQ6 addressed the overall agency strategy and whether it was effectively empowered, implemented, or ignored by the contracting officer's program and functional leadership. The last question asked

the contracting officer to look back at some of the tradeoffs they identified before or during the program performance and whether they would have decided to accept them as better alternatives.

Before conducting these interviews, the researcher gathered a significant amount of archival data, mostly through open source, to assist the researcher in identifying suitable cases for this study. This was a topic that the agency wanted to address based on its published identification as one of its top management challenges, the researcher expected to receive enough data on this topic to proceed with his research without any impassable obstacles (Office of the Inspector General, 2019). This does not mean that the researcher was not ready to provide some clarification to agency representatives about the scope of this research if asked. The researcher expected that an agency representative would need to approve any potentially proprietary or classified information to be presented and would likely need to review proposed submissions to confirm no such information has been included. The researcher had experience with these procedures, commonly utilized to provide technical and professional researchers submitting white papers to conferences. This was also helpful for educational researchers submitting research and confirming with the participants through open-source research that no such information was included.

Data Organization Plan

A strong data organization plan ensures that a researcher effectively records and organizes the accumulated data, including the archival data collected through the interview process (Creswell & Poth, 2018). Implementing an in-depth cataloging system is a reliable method for collecting the raw data generated from the interview process and identifying recurring themes (Yin, 2018). Documenting and creating records of received information that either confirm or question some of the archival data can strengthen the overall research activity,

thus fortifying the validity and reliability of the study (Creswell, 2014). The interviews provided the researcher the proper engagement with the study participants and the subjective viewpoints important to case study research (Rashid et al., 2019). The researcher documented these engagements in the researcher's field notes and recordings. The structure of the interview questions was designed to support a dependable cataloging system for the data generated by the interview process (Yin, 2018). The interview guide (see Appendix A) was developed and organized to echo the two primary research questions that separated the DoD contracting officer experience from their retrospective view and to conduct deeper research into the professional experience portion. The pre-interview categorization step utilized archival data to predict high-probability responses to the seven questions and group responses that fall into a common theme (Creswell, 2014). The post-interview categorizing (coding) was transcribed into an electronic format and then analyzed to identify potential emergent ideas and interpretations for further discussion and potential interview follow-up (Rashid et al., 2019).

Privacy, requested anonymity, and confidentiality were of great importance to the researcher, the study, and the participants (Yin, 2018). The researcher completed field notes and interview transcriptions, and all participant identifiers were replaced with a pseudonym, generated by the random number generator in Excel between one and eight. The purpose of this research was not to identify topics to blame the agency; it was to assist the agency in improving its operational readiness and contract management by identifying viable improvement opportunities. A research journal was utilized to document key findings, validate the data analysis process, identify emergent categorical themes (coding), research communications, and record the researcher's reflections following each interview or archival data collection (Rashid et al., 2019; Yin, 2018).

Creswell (2014) discussed the critical requirement for data security and how the researcher is responsible for the security of collected research data. As mentioned, the DoD imposes its data security requirements, which strongly mirror Creswell's and enforces theirs under public law but subject to the Freedom of Information Act of 1974 (FOIA). This law was amended in 2016 to reflect the online nature of most government records (Freedom of Information Act, 1974/2016). The DoD provides a detailed handbook for submitting proper requests and includes a list of exceptions under FOIA for which requests will likely be rejected (Department of Defense, 2018). The researcher ensured that his requests followed these requirements and that any published findings were compliant with this law and all required regulations and guidelines.

Summary of Data Collection & Organization

The proposed data collection and organization plans for this case study included investigative interviews, archival data research, and interview follow-ups where appropriate to provide substantial analysis, topical interpretation, and well-supported findings. Participant interviews were structured as presented in the interview guide (see Appendix A), with follow-ups based on rational inquiry generated by initial responses. The data organization plan enabled the subsequent data analysis to reveal some emergent ideas, themes, and interpretations. This process is discussed in the next section. Due to the significant engagement with current and former DoD personnel, the researcher had additional responsibilities to ensure the collected data complied with all rules, regulations, and statutes, including all DoD information disclosure processes and procedures.

Data Analysis

Before conducting the proposed research, this section defined the processes that the researcher employed to effectively analyze the data collected and organized utilizing the plans detailed in the previous section. This section included the proposed process for reading and depicting emergent ideas, describing and classifying codes into themes, and developing and evaluating proposed interpretations of the collected data. It also described the data representation process and the methods for triangulating the collected interview data.

Emergent Ideas

This subsection describes how emergent ideas were captured and recorded as they were discovered during the data collection process. Emergent ideas are the predecessors to the anticipated emergent themes that were hypothesized in the next subsection and presented again in Section Three. These findings were presented, and emergent themes were interpreted. The researcher identified significant statements and quotes that reoccurred across all or a significant majority of the interviews, potentially leading the researcher to commonalities and patterns between the participants' actions and results experienced (Creswell, 2014). The researcher documented and reflected on this process within the research journal and anticipated generating logical interview follow-up questions to those already proposed in the Interview Guide (see Appendix A) based on the initial review of interview responses. The researcher discovered a group of emergent ideas and presented them in Section Three by examining common responses and then analyzing the correlations between different responses to initial questions and developing follow-up questions.

Coding Themes

This multiple case study design subscribed to the post-positivist philosophy. The researcher focused on the sole-sourcing reliance issue as an unacceptable condition that the DoD organization strives to minimize and possibly eliminate (Creswell & Poth, 2018). This design structured the process of describing participant experiences with sufficient detail to enable the follow-on process of thematic coding. The interview results were read through multiple times, in a different order at times, and grouped into predetermined or newly identified classifications, or codes, from which common themes emerged (Creswell & Poth, 2018). The employed coding method was primarily deductive, given that the problem statement has roots in the DoD agency's 2019 report identifying the sole sourcing reliance topic as one of its top challenges (Office of the Inspector General, 2019). Deductive codes include those described in the 2019 DoD report, such as defense-unique requirements, diminishing sources, obsolete materials, and active patents held by suppliers (Office of the Inspector General, 2019). While these conditions likely contributed significantly to the overall issue, the researcher anticipated that these would not be all-inclusive. As predicted, the interviews revealed additional codes added to the final code classification. From the final code classification, the researcher developed a general textural description and provided a contextual landscape of the setting surrounding the individual experiences of typical DoD contracting officers from which the coding themes emerged (Rashid et al., 2019).

Interpretations

According to Yin (2018), the case study design approach includes a cohesive, well-rounded understanding of the topic's complexity and is constructed through collected qualitative data. This study was performed primarily through interviews and documentation research. The interpretive data analysis was completed through direct interpretation and categorical

aggregation (Yin, 2018). Direct interpretation is simply examining a set of occurrences and proposing an explanation for them. While some conclusions yielded to the "cause and effect" process, not all root causes were easily identifiable. Through the identification of emerging ideas and coding of data described in the previous two subsections, categorical aggregation is the process by which additional interpretations are developed into emerging themes (Yin, 2018). These interpretations, if properly processed and presented by the researcher, offer the reader new insight into the case study topic and enable them to draw independent conclusions. Readers still make some generalizations based on personal or secondhand experiences (known as naturalistic generalization). However, the effective coding of emerging themes under categorical aggregation reveals how the research topic exists across several cases (Cypress, 2017).

Data Representation

The collected data was represented using qualitative analysis software, which enabled the researcher to review multiple presentation formats based on the coding classifications and quantity of data within each. The researcher identified the best format structure for presenting the collected data to achieve three representation objectives:

1. The data was represented and displayed so the reader understood the basis for the data collection plan, organization, and why it was collected.
2. The data presentation affirms the reliability and validity of the collected data to establish the credibility of the resultant findings.
3. The presentation compares the findings with the research questions and connects the relationship of the findings with the conceptual framework and the prevailing literature.

Analysis for Triangulation

As discussed in Section One, the proposed case study research involved a brief preliminary survey that identified respondents who were current or former Department of Defense (DoD) contracting officers whose experiences would best contribute to the research topic. Triangulating for validity can be a challenge; however, when interview data is the primary source of data collection, the collected interview data can be more subjective than objective in nature (Seidman, 2013). To alleviate this, the researcher employed a triangulation method by aligning the interview data with that received from the DoD agency through open sources to improve the reliability and validity of the research. Triangulation is best described as utilizing multiple sources to improve the validity and reliability of collected information and strengthen proposed interpretations of the experiences of research study participants (Farquhar et al., 2020). While some researchers have discussed the limited utilization of triangulation in qualitative research, Farquhar et al. (2020) have recently described how applying triangulation when conducting flexible method research in case studies is both appropriate and useful.

Summary of Data Analysis

The researcher employed a set of processes to effectively analyze the collected data, such as to enable the presentation of significant and reliable findings in the final section. The data was gathered from a combination of DoD contracting officer interviews, open-source reports, and information received through directed FOIA requests. The agency was formatted and organized to enable the effective identification of emerging ideas, subsequent classification and coding of these ideas, and findings to develop significant themes and enable deductive interpretations through categorical aggregation. The findings revealed potential opportunities for the agency to address important root causes for its detrimental reliance on sole sourcing. The researcher

formatted the data analysis presentation and employed an effective triangulation strategy to improve the reliability and validity of the proposed study, which is described in more detail in the next section.

Reliability and Validity

There is a presumed lack of objectivity in most qualitative studies due to their subjective nature; researchers must take additional steps to ensure that the reliability and validity of their research are clear (Creswell & Poth, 2018). This is especially true for case study design approaches, in which the data collection consists of primarily archival data collection and interviews with participants familiar with selected cases (Yin, 2018). In most qualitative research studies, interview questions are typically fluid, open-ended, and less quantifiable than in quantitative studies (Creswell, 2014). Seidman (2013) maintained that qualitative researchers who are careful, prepared, and mindful of their data collection, organization, and analysis procedures could promote a strong sense of reliability and validity. To maintain the reliability and validity of the interview instrument, the researcher applied several strategies discussed in the following subsections.

Reliability

The reliability of any given research study can be summed up as the assurance that it was performed in such a manner that another researcher can subsequently trust its findings and base their follow-on research on those findings. Lincoln and Guba (1985) established four criteria in 1985 that have become benchmarks for determining the reliability of a qualitative study. The scholars believed the four aspects of trustworthiness must be present in both quantitative and qualitative research: truth value, applicability, consistency, and neutrality (Cypress, 2017). The qualitative criteria are credibility, transferability, dependability, and confirmability (Cypress,

2017). Each criterion was addressed in this subsection to show how the researcher ensured reliability throughout the study.

The credibility of the researcher's work, whether it accurately depicted the contracting officers' experiences, was strengthened through two measures. First, the data and interpretations of the cases the participant contracting officers recalled were triangulated with the archival information received through open source and FIOA to confirm as much alignment as possible. The researcher also engaged in the process of member checking, in which interview follow-ups to seek clarification or deeper understanding to assist the researcher in strengthening the credibility of the collected data. Transferability referred to how relevant and applicable the data collection and findings were to those in similar fields of study; in this case, the government contracting industry, primarily involved in aerospace and defense. Lincoln and Guba recommended an approach deemed the thick description, in which the researcher provides a robust and detailed account of the data collection experience. This includes how the data was collected, when and how the interviews were conducted, and other information that helps establish the setting and the environment under which the data collection occurred (Mohammadpour et al., 2020).

Dependability, which sounds similar to reliability, can best be reinforced through peer reviews and cross-examining the collected data from reliable authorities (Cypress, 2017). For this study, the researcher had his collected data reviewed by the participant interviewees to confirm that their input was properly transcribed and interpreted. Also, it accurately reflected the challenges the agency has been communicating on a general basis in its published management reports. The participants reviewed the transcribed interviews, which contributed to the confirmability of the collected data. This ensured that the collected participant information was

accurately documented and that any omissions were clearly non-contributory and did not alter the perspectives and thematic messages that the participants were communicating.

Validity

The validity of generated and collected data is generally determined by the researcher's ability to describe data collection decisions properly. This process demonstrates substantial engagement and tenacious reflection; it can provide accurate interview transcription and assist with achieving data collection saturation (Cypress, 2017). To establish the validity of the proposed interview guide, the researcher applied several proven practices. In addition to the use of bracketing, described in detail in the next section, the researcher employed a significant amount of triangulation. As mentioned earlier in the data analysis section, this process is critical in achieving saturation to ensure the validity of the research study.

To ensure sufficient triangulation is applied, the researcher used the interview questions developed in advance and listed in Appendix A, ensuring that they adequately addressed all research questions. Next, the interview questions were submitted for review to Liberty University's Institutional Review Board (IRB) and approved once recommended adjustments were implemented. The interview questions were replicated for each participant, which allowed for multiple levels of triangulation by comparing the responses of different DoD contracting officers to their specific program circumstances and archival data. Member checking aided the participants by providing an opportunity to verify their responses for accuracy based on follow-up recollection of information. The researcher examined several DoD cases involving sole source reliance issues that were referenced in the interviews to effectively communicate and confirm the emerging ideas, themes, and resultant findings of the study. This ensured the researcher achieved an appropriate level of data saturation.

Bracketing

As discussed earlier, the researcher had to ensure that his professional government contracts experience did not influence the collection of relevant data, such as to place its objectivity or that of the derived findings into question. The controlling of unintended bias and inadvertently leaning the research toward anticipated themes was performed by applying the proper amount of bracketing. During this process, the researcher set aside his presumptions and previous understanding of the research topic based on his professional experiences and allowed the themes and findings to emerge naturally. Therefore the themes could be logically explained without prejudice or bias (Creswell & Poth, 2018). The primary purpose of bracketing was to ensure that the experiences, perspectives, and findings communicated were from those of the participants rather than the researcher (Gregory, 2019).

The researcher's primary bracketing technique was to filter out any cases within the DoD in which he had personal experience or previous insight beyond public knowledge. This included any DoD programs in which the researcher may have known a participant through past professional working relationships or any personal networking associations. The researcher accomplished this by seeking out participants from those currently or formerly employed as DoD contracting officers with whom he had no previous business interactions. He successfully secured participants from outside the researcher's professional experience in the aerospace industry. By engaging with participants with whom the researcher had no prior relationship, the research study introduced new viewpoints to the researcher about the DoD sole sourcing reliance issue.

Summary of Reliability and Validity

When properly addressed, reliability and validity provide two of the most critical elements to a qualitative research study by elevating the status of the findings from mere speculations to credible discoveries. These revelations are more likely to be implemented by readers of the study seeking to improve the conditions that the research study addresses. The reliability of a qualitative study contains four criteria: credibility, transferability, dependability, and confirmability (Cypress, 2017). Validity is achieved when a researcher can confirm that collected data has been properly collected, accurately transcribed, thoroughly analyzed, and sufficiently reviewed to appropriate saturation (Creswell & Poth, 2018). These must be performed proactively through effective techniques, including generating a robust data collection plan, a strategically prepared interview guide (such as Appendix A), and triangulation through archival data. The researcher should also engage in member checking and vigorous data analysis that enables emerging ideas and themes. These strategies, combined with bracketing techniques, can assist in preventing undue partiality and unintended professional bias to skew the study's findings toward anticipated themes that lack sufficient reliability and validity.

Summary of Section 2 and Transition

In Section Two, the researcher reaffirmed the purpose statement, discussed his role and research methodology, identified the participant characteristics, and described how the DoD contracting officer population was solicited. These procedures assisted the researcher in identifying the most appropriate sample size for this holistic multiple case study. Following that, the researcher proposed the data collection plan, data organization plan, and data analysis techniques. Finally, the anticipated procedures to ensure reliability and validity were presented.

This study examined the DoD source selection process and procedures and identified contributing factors to the increasing sole-source reliance issues within the DoD contracting officer community. The holistic multiple case study design was chosen based on the context of the study and the proposed research questions. The researcher utilized a combination of open-source data gathering, unclassified interviews, and supplemental information as primary means for data collection, which were coded relevant to the established conceptual framework for this study. The researcher employed confidentiality and security measures to prevent the disclosure of both participant information and any proprietary or classified information. This included active collaboration with the appropriate DoD authorities and those directed by the IRB. Section Three presented the findings from the anticipated research and relevant applications to the professional practices of supply chain management and government contracting.

Section 3: Application to Professional Practice

Overview of the Study

This qualitative multiple case study examined significant issues created within the Department of Defense (DoD) agency due to its increasing reliance on sole-source manufacturers and suppliers. This included potential threats to operational readiness and significant contractual performance and delivery delays. As mentioned in Section One, sole sourcing has both avoidable and unavoidable conditions and does not always result in detrimental situations for the prime contract manufacturer. Contractual commitments for one supplier to fulfill all current and future demand volume of a product or commodity among a field of qualified suppliers, known as single sourcing, do not create the same detrimental reliance issues so long as other qualified suppliers can replace the selected one (Li & Debo, 2009; Namdar et al., 2018). This investigation into the impacts of sole-source reliance on DoD programs became an important endeavor when sole-sourcing was identified as a significant contributor to decreased operational readiness. The DoD's Inspector General listed sole-source reliance among its top 10 management challenges in the fiscal year 2020 (Office of the Inspector General, 2019).

Every manufacturing industry must address sole-sourcing reliance issues, including diminishing resources, technological obsolescence, global material shortages, or reductions in the number of reliable vendors for necessary products (Lewis et al., 2013). For major hardware and capital equipment needs, sole-sourced components and sub-assemblies are more likely to affect the timely manufacture and delivery of these parent assemblies, from small electronics to high-tech machinery and multi-million dollar aircraft (Hamdi et al., 2018). In 2006, the DoD established the DoD Diminishing Manufacturing Sources and Material Shortages (DMSMS) program to address these issues and propose better sourcing strategies for DoD prime contracts

(Saunders, 2006). This program requires DoD prime contractors to identify any single source items within the bills of materials for proposed hardware. This included those the U.S. government is not granted data rights and a strategic plan for their continuous supply during their production and sustainment phases (U.S. Department of Defense, 2006). The focus of this study was to identify how the DoD's acceptance of component, assembly, and major subsystem sole-sourcing within many of its critical hardware procurements. This contributed to the decreased operational readiness witnessed by DoD contracting officers and identified by the DoD Inspector General as a top agency challenge to overcome (U.S. Department of Defense, 2019).

The purpose of exploring strategies that some U.S. DoD contract officers use to reduce sole-sourced critical equipment components from the supply chain was to better understand the engagement by DoD contract officers with prime contract suppliers. The flowing down of requirements for reducing the detrimental reliance on sole-sourcing by the DoD when contracting for the large-scale purchases of critical defense equipment, hardware, vehicles, and platforms. Developing an understanding of how DoD contracting officers have been observing and addressing the sole-source reliance issue over the last 30-40 years. This was needed to validate the concerns of the DoD leadership and inquire whether there were measures taken to reduce its occurrence. Hence, the goal of this study was to investigate potential opportunities for the DoD to address the sole-source reliance issue; accordingly, to learn from its own past, determine how much the agency may be contributing to its current situation, and move forward with a stronger strategy.

A thorough review of the scholarly and professional literature was performed to support the purpose and objective of this study. The researcher embarked on the literature review as a foundational step in building a thorough understanding of the investigated topic through existing

literature. This study sought to balance the historical information obtained with as much written about the current state of this issue as possible. Scholarly and professional literature was acquired from online academic databases such as ProQuest and Liberty University's Jerry Falwell Library and significant defense industry periodicals such as National Defense Magazine and Aerospace America. The focus of this study was on the U.S. DoD. The literature review included most of the applicable government reference publications, such as the Federal Acquisition Regulations (FAR), the Defense Federal Acquisition Regulations Supplement (DFARS), and the Diminishing manufacturing sources and material shortages (DMSMS) guidebook. In addition, academic print materials and doctoral dissertations from fellow Liberty University students were reviewed as a literature review component. Over 92 articles were reviewed, with a majority published no earlier than 2017.

The literature review led the researcher to identify gaps within the literature, which then led to an improved conceptual framework developed for this study. One of the significant gaps identified within the literature was the lack of information written by former government contracting officers who would have the most to contribute to the field of government contracting. This has become an increasing need with the recent national pandemic and domestic supply chain issues. While the existence of academic literature by qualified contracting officers was not nonexistent, it was also not abundant. Two of the study participants directed the researcher to additional source materials that they refer to frequently in their follow-on careers on the private sector side of government contracting. However, the need still exists to expand investigations into past government contracting practices (Howard et al., 2016) and hold government contracting more accountable (Flammer, 2018), and not merely accept what most in the higher levels of leadership call inevitable (Harper, 2021). On a macro level, one consistent

gap identified within the literature was the need to apply supply chain practices that work well in non-government contractual relationships. These practices work well within the DoD contracting community without applying political or organizational pressures (de Rassenfosse et al., 2019). This study attempted to reduce these gaps by examining how the sole-source reliance issues developed over the past 40 years and how they impacted the contracting performance of the DoD agency.

The theory of production competence, theory of trade-offs, and resource-based view were all contributing theories to the conceptual framework for this research study. The researcher constructed the conceptual framework for this qualitative multiple case study by merging the applicable process steps within the U.S. DoD supplier sourcing process (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2020). This researcher planned to expand on previous literature about the DoD source selection process and identify how contracting officers may be inadvertently contributing to the increased sole-source reliance issues.

The next step in this multiple case study research was to collect data on the sole sourcing reliance issues experienced by DoD contracting officers. The data was collected through a combination of open-source information, DoD statistics, and non-proprietary one-on-one participant interviews. The researcher utilized an initial population survey to implement a purposeful sampling method for identifying respondents who should be fully interviewed using the seven interview questions shown in Appendix A. New research data was collected through semi-structured interviews with qualified research participants. These individuals were former or current DoD contracting officers who managed a sole-source prime contractor and experienced any programmatic issues resulting from the sole-sourced arrangement. The researcher acted as the primary data collection instrument and consistently asked the same set of open-ended

questions as well as relevant follow-up questions based on participant responses to the original set. The researcher collected field notes and transcribed recordings of each video call associated with the interviews. The researcher then analyzed each interview transcript, listening to the associated recording to confirm accurate transcription while reviewing the field notes and narratives. The researcher strictly adhered to the protocols prescribed by the IRB, including obtaining proper approval prior to the commencement of the field study, obtaining participant consent, and implementing proper protocols for data security. These protocols were followed during all interactions with the study participants, before, during, and after each interview.

Data collection was only discontinued when the participant interviews began to stray far off topic and the primary set of interview questions was answered. Data saturation was considered achieved based on the collected interview transcripts repeatedly generating themes previously identified in earlier interviews (Creswell & Poth, 2018). Collected data was analyzed by separating and grouping similar descriptive statements and words to develop the emerging themes. Triangulation was accomplished by interviews with former and current DoD contracting officers and those with extensive government and private corporate experience.

The data collection and analysis process included eight qualified research participants, research field notes, and the development of the emerging themes described in detail within the next section. These themes correlate directly to the research questions and sub-research questions from Section One of this study. The themes provided significant insight into potential solutions that fulfill the purpose of this study and contribute to the investigation of this study's identified business problem.

Presentation of the Findings

This study explored the issues generated within the DoD agency due to its increasing reliance on sole-source manufacturers and suppliers using a qualitative, multiple case study. This included potential threats to operational readiness and significant delays in contractual performance and deliveries. The research investigated how DoD contracting officers addressed situations that increased the probability of generating sole source contracting arrangements and proceeded with a supplier as a sole-source provider based on limitations such as government requirements or unique supplier capabilities. The developed findings presented in this subsection support some of the anticipated themes implied in Section Two. However, it also revealed new themes due to the significant information obtained from the DoD contracting experiences among the case study interview participants, including former and current DoD contracting officers. Data collected from the interview process, directly from the interviews and follow-up research, led to the generation of pertinent and practical themes. The following interpretations include similarities between the sole sourcing reliance incidents experienced by study participants and hypotheticals suggested within the research questions. The data gathered for this case study came from multiple perspectives, including recently retired DoD contracting officers starting their civilian careers in the corporate defense industry and others with long-time experience as corporate supply chain consultants or company executives. By utilizing the pre-interview survey, the researcher was able to identify those with the common experience of formerly managing at least one sole-source subcontractor in their role as a DoD contracting officer and experiencing programmatic issues due to having the sole-sourced subcontractors among its program supply chain base.

The research data was gathered initially from interviews of these participants in the DoD contracting process, followed by supplemental academic research on the case study incidents presented by the participants. This helped provide contextual background and supplemental information to corroborate each participant's recollection of events. The researcher utilized three study instruments to gather the necessary data and interpret the data for emerging themes: an initial pre-screen recruitment request, personal interviews, and the researcher.

The interview recruitment request was disseminated through the open forum message boards of both the AIAA and NCMA after securing the proper permissions and guidance from the respective administrators of each organization's forum. The message board postings were clear that the interviews would not include discussions of any DoD sensitive or classified information. Also, it included a request for assistance in reaching out to others who may not frequent the organization's message boards but might be willing to discuss the sole source reliance issue as they have experienced it. Of the hundreds of regular AIAA and NCMA members who read the recruitment request posting, 36 individuals requested the full survey, and 8 completed the survey to participate in the study. Most of the remaining requests had no response; three interview requests stated they did not anticipate having sufficient time due to their workloads during the time of year the interviews were being requested. The interview requests were made in August 2021, right as defense spending for the current fiscal year was beginning to close and budget requests for the next fiscal year needed to be finalized. Budgets must be submitted in time to be addressed prior to the new fiscal year beginning on October 1st. August, September, and October are the worst months to ask those in the DoD contracting community to take on additional tasks (U.S. General Services Administration, 2018). Due to the timing, the response rate to the interview requests was predictably low, with less than 1% of the

potential interview pool agreeing to interview. However, utilizing the pre-interview screening survey, the researcher successfully located and scheduled eligible interview participants. They were assigned a random pseudonym, which served as the participant's identification number throughout the study. The participants responded via email, acknowledging receipt of the consent agreement approved by the Liberty University Institutional Review Board (IRB), which included the structure and scope of the study (Creswell & Poth, 2018). Using pseudonyms rather than participant names ensured anonymity (Yin, 2018). The demographics of the interviewed contracting officers included both retired and current contracting officers, those still serving in a government capacity, and those now working in private practices. In addition, all participants were allowed to review the researcher's supplemental research and conclusions to confirm both the appropriateness and proper alignment with their inputs and insights (Yin, 2018).

Interviews were semi-structured, allowing the investigator to delve deeper or remain broader in his inquiries regarding each of the seven research questions (Seidman, 2013). For some interviews, the response to one of the direct interview questions needed to be followed up by secondary questions to delve further into the discussion topic, addressing key issues pertinent to the study (Seidman, 2013). Each interview was recorded using the audio recording device within the researcher's Microsoft Teams application and supplemented by the researcher's field notes of each interview session.

A thorough evaluation of the transcribed interviews using proper coding and synthesis revealed a distinctive set of themes or patterns in the interviewees' experiences. The emergence of clearly repetitive themes and participant perceptions signaled achievement of data saturation and adequate sample size, despite the low number of interview participants (Malterud et al., 2016). Each participant was able to provide the researcher with significant research leads,

including both personally experienced knowledge and commonly known information about the sole sourcing reliance issues during their tenures as DoD contracting officers. Validity measures included the referenced saturation, triangulation of key responses through common theme comparisons, and voluntary member checking through open source and journal article research reconciliation (Creswell & Poth, 2018). Saturation was deemed to be achieved when the analysis of the collected interview transcripts generated themes previously identified in earlier interviews (Creswell & Poth, 2018). Triangulation was accomplished by interviews with former and current DoD contracting officers and those with extensive government and private corporate experience. Member checking generated a few participant follow-ups, but no corrections or significant changes were suggested to the transcripts. Following these processes, the researcher reviewed the findings and applied personal judgment and prior industry experience to further interpret the data collected. The researcher then applied these interpretations to the overall problem of DoD sole source reliance. Throughout the data collection process, the researcher utilized some of his observations and guidance based on professional judgment and personal experience (Seidman, 2013).

Themes Discovered

Prior to collecting data through the proposed interviews, the researcher needed to structure how he would describe the participant experiences with sufficient detail to enable the follow-on process of thematic coding. The interview results were read through multiple times and grouped into anticipated or unexpected classifications or codes (Creswell & Poth, 2018). It was from these codes that the discovered themes emerged (Creswell & Poth, 2018). During the interviews, the researcher employed a technique called analytic memoing. The researcher recorded instant reflections during the interview process and later coded the notes as additional

data for the research study (Rogers, 2018). This method of coding helped keep the interview flow progressing as each participant walked through how their experiences connected to the emerging themes, both anticipated and unanticipated. Coding is not an exact science with right and wrong answers; it was important for the researcher to make notes on as many data points as possible and then later determine which themes were more recurring than others (Rogers, 2018).

Table 1 shows how the experiences of the eight interview participants were coded and categorized as their interviews progressed until all eight were completed, focusing on those themes that occurred more than once among the eight interviews conducted.

Table 1

Anticipated Sub-Themes (in Green) and Unanticipated Sub-Themes (in Red)

Thematic Category (Section 1)	Production Competence			
Sub-Themes	Lack of Proactive Supplier Risk Management	Lack of SCM Expertise among PM's	Lack of Interested Suppliers	Lack of Capable Suppliers
Participant 1				X
Participant 2	X		X	X
Participant 3				X
Participant 4	X	X	X	X
Participant 5	X	X		
Participant 6	X	X	X	X
Participant 7	X	X		
Participant 8		X	X	X

Thematic Category (Section 1)	Non-Pricing Factors in Source Selection Decisions		
Sub-Themes	Patented Products	Government Requirements	Aggressive Schedules
Participant 1	X		X
Participant 2	X		
Participant 3	X		X
Participant 4	X	X	
Participant 5			
Participant 6	X		
Participant 7		X	
Participant 8	X	X	

Thematic Category (Section 1)	Additional Conditions that DoD CO's have to address		
Sub-Themes	Obsolescence	Increasing Non- Defense Applications	Mergers & Acquisitions
Participant 1	X	X	
Participant 2			X
Participant 3		X	
Participant 4		X	
Participant 5	X	X	X
Participant 6			X
Participant 7			X
Participant 8		X	

The researcher decided to keep the pseudonyms as generic as possible because most participants still participate in the defense industry in some capacity. While it was acceptable for participants to be able to identify themselves in this presentation of findings based on certain quotes, it was important to preserve their anonymity to the highest extent possible. The use of “Participant #” for each interviewee kept their descriptive, identifiable characteristics to a minimum. This presentation used masculine pronouns for each participant regardless of gender.

The researcher advised each participant at the start of each interview, and none had an issue with this protective measure.

Once these recurring themes were identified, the researcher next re-examined the findings to determine which subthemes were sufficiently recurring and which had sufficient data from the interviews to warrant consideration as an emerging theme from this study. Table 2 shows how those codes with higher propensity were categorized and reorganized into the three primary emerging themes discussed below. Each of the specific subthemes in Table 2 had at least a 50% occurrence among the experiences conveyed by the eight interview participants and thus were included as those warranting further analysis and discussion.

Table 2*Primary Emerging Themes*

Primary Emerging Themes	Avoidable Sole Sourcing Reliance		
Sub-Themes	Patented Products	Lack of Interested Suppliers	Lack of Capable Suppliers
Participant 1	X		X
Participant 2	X	X	X
Participant 3	X		X
Participant 4	X	X	X
Participant 5			
Participant 6	X	X	X
Participant 7			
Participant 8	X	X	X

Primary Emerging Themes	Diminishing Suppliers & Resources		Supplier Performance Risk Management	
Sub-Themes	Increasing Non-Defense Applications	Mergers & Acquisitions	Lack of Proactive Supplier Risk Management	Lack of SCM Expertise among PM's
Participant 1	X			
Participant 2		X	X	
Participant 3	X			
Participant 4	X		X	X
Participant 5	X	X	X	X
Participant 6		X	X	X
Participant 7		X	X	X
Participant 8	X			X

Rogers (2018) identified two methods for analyzing data: interpretive and aggregative.

Researchers use interpretive to consider responses from study participants and determine how the responses inform the research questions. Conversely, a researcher uses the aggregative method

when posing standard questions and analyzing the responses to find typical versus different answers. The process described above shows how this researcher applied the aggregative analysis technique to analyze the collected data. This process was consistent with the anticipated themes derived from the research questions and conceptual framework to obtain the study's findings. The researcher successfully utilized the coding system above to capture the interview elements that contributed most to the research questions, then categorized the responses into the emerging themes based on keywords and phrases. Due to the limited number of participants and the structured nature of the interviews, the researcher was able to use Microsoft Excel for the coding process. The interviews were conducted using Microsoft Teams video teleconferencing and enabled transcription with the consent of the interview participant.

The following subsections shed light on several themes identified during the data collection process that was linked to each of the study's research questions. The researcher has structured these into three primary themes, each with at least two secondary topics supporting them, and summarized them in the following table. Analysis of the collected data began with confirming the research questions' alignment to the participant questions and their responses, as shown in Table 1. Initial code creation occurred at the beginning of the data analysis. It continued throughout the data collection process; the researcher interviewed and conducted follow-up research to distinguish the emerging themes from outlier concepts. To mitigate bias in the research, the researcher maintained discipline toward using the standardized interview questions for each participant, including making the best attempts to steer the interview discussions back toward the question topic and asking the questions in the same order for each participant (Rashid et al., 2019).

Table 3 demonstrates the alignment of each participant question with the study's research questions and the themes identified from participant responses to each question on the survey. The study's results by emergent themes highlighted their relevance to each research question. The themes that emerged from the data analysis included avoidable sole sourcing reliance, diminishing supply base and resources, supplier performance risk management, and process improvement implementation.

The first theme was avoidable sole-sourcing reliance. There were missed opportunities or a lack of foresight, resulting in the need to sole-source a product or service. Many participants indicated that they had inherited sole-sourced projects or were "too low" in the agency to influence the sourcing process of a project. At the same time, some admitted that they found it easier to justify sole sourcing of a project rather than conduct an extensive source selection for a given activity.

The second theme was diminishing supply base and resources. Identifying qualified suppliers willing to submit competitive proposals and quotations became an increasingly difficult challenge. Securing limited resources, whether technical expertise or rare materials, has continually existed but has grown significantly within the defense industry.

The third and final theme was supplier performance risk management. According to many research participants, understanding how production competence and past performance determine the potential performance of suppliers selected for future contracts seemed to be undervalued. The participants indicated that supply chain considerations and reducing supplier risks were secondary focuses in many of their projects rather than at the forefront of the department's critical selections.

Table 3*Research Questions, Participants Questions, Alignment, and Themes Identified*

Research Question	Research Question Alignment	Themes
1. What strategies do U.S. DoD contract officers use to reduce sole-sourced critical equipment components from the supply chain?	RQ1	- Avoidable Sole-Sourcing Reliance - Supplier Performance Risk Management
1a. How is the U.S. DoD identifying current defense systems and platforms that contain components that are either sole-sourced or are at an increased risk of becoming sole-sourced due to a diminishing supply base?	RQ1a	- Diminishing Supply Base & Resources - Supplier Performance Risk Management
1b. How have the U.S. DoD contracting officers historically required prime contractors to address sole source reliance risks within the supply chain sections of their submitted proposals?	RQ1b	- Avoidable Sole-Sourcing Reliance - Supplier Performance Risk Management
1c. How has the reliance on sole-sourced hardware and components within the U.S. DoD supply chain network affected the organization's level of operational readiness?	RQ1c	- Avoidable Sole-Sourcing Reliance - Diminishing Supply Base & Resources - Supplier Performance Risk Management
1d. Does the U.S. DoD have a current strategy to address the increasing reliance on sole-sourced materials and components?	RQ1d	- Avoidable Sole-Sourcing Reliance - Supplier Performance Risk Management
2. What are the trade-off effects of significantly reducing sole sourcing within the U.S. DoD supply chain?	RQ2	- Avoidable Sole-Sourcing Reliance - Supplier Performance Risk Management

Interview Question	Research Question Alignment	Themes
IQ1. When your program / project was originally proposed, were there any major subsystems or components within the overall platform or system already identified as sole-sourced due to unavoidable factors such as technology patents or government-directed outsourcing?	RQ1a	- Avoidable Sole-Sourcing Reliance
IQ2. Was there any internal analysis conducted to identify sub-systems, components or raw materials that had an increased risk of becoming sole-sourced due to a diminishing supply base or pending governmental or industry activities?	RQ1, RQ1a	- Diminishing Supply Base & Resources - Supplier Performance Risk Management
IQ3. To what extent did your program require its prime contractors and sub-tier contractors to identify, address and monitor sole source reliance risks within the supply chain sections of their submitted proposals to your team?	RQ1, RQ1b	- Avoidable Sole-Sourcing Reliance - Supplier Performance Risk Management
IQ4. Were these contractors empowered, or possibly directed, after contract award to negotiate with its sole source and single source suppliers regarding their operations and risk reduction activities to improve their likelihood of timely and quality product deliveries?	RQ1, RQ1c, RQ2	- Supplier Performance Risk Management
IQ5. How did the level of reliance on sole-sourced hardware and components within your assigned programs and projects affect its internal program management and the subsequent program performance, including initial contract milestone completion dates, sub-system and component quality, and	RQ1, RQ1d, RQ2	- Avoidable Sole-Sourcing Reliance - Diminishing Supply Base & Resources - Supplier Performance Risk Management

the organization's forecasted level of operational readiness to utilize the contracted platform or system?		
IQ6. How well do you believe the current or former DoD strategy (at the time of your program experience) effectively addressed the likely reliance on sole sourced materials and components during the production and operational lifespan of your program's final product?	RQ1, RQ1a, RQ1d, RQ2	- Supplier Performance Risk Management
IQ7. What do you believe would have been some of the trade-offs that had to be made to reducing sole sourcing within your program, and would you have made them given those possibilities?	RQ2	- Avoidable Sole-Sourcing Reliance - Supplier Performance Risk Management

Interpretation of the Themes

The emerging themes revealed during the research and interviews aligned significantly with the anticipated themes from Section 1. Each emerging theme also had multiple subthemes that aligned with some of the hypothesized topics. However, the utility of this research was not only in validating much of the anticipated themes but revealing some new themes that the researcher hopes the readers of this dissertation may find helpful. As they also seek to learn more about the sole-source reliance challenges facing the Department of Defense (DoD) and the defense industry. While this research was conducted during the 2020-2021 pandemic, the management challenge for the DoD was published in October 2019, which preceded the pandemic. A common trait of the themes was their origins also preceding it. However, this does not preclude that the conditions of the pandemic were not also influential on this issue. The

interviews were conducted during the summer and fall of 2021; the participants were aware of additional instances supporting these themes and subthemes.

The subthemes for avoidable sole-source reliance were focused on addressing three areas: patented (or otherwise legally protected) products, the lack of identifying enough capable sources, and confirming the interest in those capable suppliers that were identified before beginning the official solicitation process. These were the three issues identified that participants believed could have been avoided or reduced in their sole sourcing relationships. Some other potential subthemes under this category were more subjectively presented by a few participants, such as the perceived desires of senior contracting officials to maintain relationships with contractors they had worked with on previous projects. However, because these data points were difficult to validate or triangulate through follow-on research within credible sources, they were discussed within the supplier performance risk management theme.

The subthemes for discussing the diminishing supply base and resources included a history of the impacts of mergers and acquisitions that characterized much of the defense industry from the early 1980s through today. Critical raw materials' supply and demand impacts have experienced both diminishing supply and increasing applications for use within the defense industry and the commercial marketplace. Many of the more experienced contracting officers interviewed had witnessed the derivative applications of key materials and processes formerly believed to be limited. Anticipating these trends and preparing for the next were among the challenges the participants posited that the defense agency has in perpetuity.

Supplier performance risk management was one of the anticipated themes from Section One, and the participants validated one of the hypothesized concerns that it had not historically been as big a focus in recent years. However, some participants were suspicious as to whether

the recent support for government-directed supplier performance risk management practices was uniformly genuine or to satisfy certain requirements. Many believed they were only implemented to satisfy a given customer. Despite the numerous research articles and industry symposiums among contracting professionals on this topic, many still see the same archaic perceptions that program managers must be the most technically knowledgeable member of a program team. However, today most of the anticipated challenges of an awarded contract are more logistical in nature.

Representation and Visualization of the Data

This section will dive into the more detailed representations of the collected data, and where possible, provide some visualizations of how the collected data manifests within the sole-sourcing reliance topic. A discussion of some of the sole-sourcing reliance experiences that participants characterized as avoidable leads this section. Next is a presentation of the history contributing most to our diminishing supply base and how mergers and acquisitions are impacting the formerly competitive nature of the defense industry. Following this, the researcher examines how a raw material that became key to many defense applications also became much more difficult to affordably acquire as its popularity in non-defense applications grew. After these themes, more external in character, are discussed, the conversation shifts to the internal emerging theme from the data collected during the interviewing process that dealt with how the participants perceived Supplier Performance Risk Management practices were being applied. The researcher anticipates that most of the themes and subthemes are not necessarily revelations to those leading the defense industry firms and the defense agency, so much as validations of the effects of some of the decisions made by predecessors (or themselves) that can be addressed.

Theme #1: Avoidable Sole-Sourcing Reliance. The first emergent theme was the significant amount of avoidable sole sourcing by the Department of Defense (DoD). This theme demonstrated that if due diligence was taken throughout the source selection process, sole sourcing could have been reduced. As mentioned in Section One, there were unavoidable situations that could have prevented awarding contracts to manufacturers on a sole-source basis. These include (a) patented products that a supplier is unwilling or unable to license a second manufacturer to produce; (b) determination that only one supplier can manufacture a requested product; and (c) lack of interest of more than one qualified supplier to receive a contract award for the requested product (Department of Defense, 2016). Within the first theme, each of these three conditions was identified through the participant responses. However, most participants also identified missed opportunities in their experience with these conditions for sole sourcing to either be avoided or have the negative effects of the reliance significantly reduced.

The first interview question (IQ1) specifically asked the participants whether any subsystems or components were initially identified as sole-sourced due to unavoidable conditions. The researcher initially believed this would generate a simple list of historical sourcing decisions made that utilized one or more of the three conditions. Each of these three conditions was validated through at least one participant's interview. The presence of these conditions was the mention of preliminary actions that the interviewees believed could have been taken to significantly reduce the likelihood of that condition occurring, if not eliminated altogether.

Addressing Patented Products. Patented products were the first condition that was most often brought up in discussions about sole-sourcing. This research and earlier studies suggested that this reason contributed far less to the overall subset of sole-sourcing decisions than

perceived. This study confirmed those results with the Department of Defense (DoD). The researcher believed this is likely because it is relatively easier for DoD contracting officers to negotiate patent rights with prospective contractors with proper foresight of overall program objectives. Patents applicable to private industry production and consumption can require significant time and investment by a prospective licensee. The U.S. government's ability to utilize a negotiated license with a patent owner and then maximize its use of a derivative patented product is governed by whether the patent owner utilized any government resources. Another option is if the patent owner developed any part of their patent during government contract performance (United States Patent and Trademark Office, 2022). Current patent laws grant the U.S. government licenses its rights to an invention if it was either conceived or reduced to practice during contract performance (United States Patent and Trademark Office, 2022). The government can secure a nonexclusive, nontransferable, irrevocable, paid-up license to utilize the invention during the term of the patent. If a contractor creates an invention during its government contract period, it must disclose the invention in writing to the contracted agency. The patented product can remain developed solely at private expense; in that case, the government is limited on how it utilizes the patent and to who else it can disclose the patented information.

Many patents held by suppliers are for inventions or applications that the government already restricts in their use and marketability. The International Traffic in Arms Regulations (ITAR) restricts and controls the export of defense and military-related technologies to safeguard U.S. national security and further U.S. foreign policy objectives (U.S General Services Administration, 2018). The Export Administration Regulations (EAR) regulate what can be exported to non-U.S. persons, and the United States Munitions List (USML) contains items, services, and technology defined as defense and space-related by the federal government (U.S.

General Services Administration, 2018). These policies tend to give the DoD an advantage when dealing with patented technology. The patent holder has very few alternatives if their patent's primary purpose is military or related applications. Additionally, while the DoD is not permitted to make a patented technology, it can ensure that prime-level contractors are aware of the competitive advantage a proposal would have if it included a successfully negotiated license for such technology. Participant 3 commented, "It was vital in many cases that we (DoD) secure a government purpose rights license, both for the current program contract award we were negotiating and for any follow-on contracts that we anticipated."

Placing the burden of such negotiations on the prime-level contractors has been a common practice within the defense industry. It has led to strategic acquisitions by large defense firms targeting the ownership assignments of patents by smaller defense suppliers (U.S. General Services Administration, 2018). Participant 6 had been on both the DoD contracting officer side and the large defense contractor acquisition side. He noted, "Securing certain patent rights was a primary motivator for many acquisitions, and we (DoD) supported those acquisitions in most cases because we knew the major defense contractor was planning to include a license for the government as a condition of a future program bid." The limited usability of some supplier patents outside the defense industry assisted DoD contracting officers by placing the burden on much of the patent licensing negotiations with the larger defense contractors. This allowed the bidding to be the prime level system integrators for their respective programs.

Lack of Capable Suppliers. The second condition discussed regarding unavoidable sole-sourcing was when only one supplier has been deemed capable of producing the required product. This must be distinguished from selecting a single supplier among multiple viable providers. This condition occurs when suppliers have been identified as possessing a unique

ability to provide a product or service that no other supplier is capable of offering (Li & Debo, 2009). While this condition exists in non-government sectors, the capabilities that drive sourcing decisions are mostly capitalistic and driven by longer-term supply and demand trends of a respective market. Factors such as necessary capital equipment, licenses to produce, access to necessary resources and others can mostly be overcome with either gradual or one-time investments if a supplier decides to enter that market. Government-imposed requirements were also a factor that could not simply be overcome. Participant 5 stated, "We knew there were multiple sources for hardware items in the commercial market space. We would reach out to those with high reputations in their respective industries, but they would simply tell us that investing what was needed to meet all of the government requirements, especially for our facilities and operations, was not worth the hassle."

Some government requirements are well-known, accessible, and available for suppliers to obtain, research, and decide on to improve capabilities. The United States Military Standards (MIL-STD), for example, defined mechanical, electrical, and operating characteristics for military components, assemblies, and subsystems with the intended goal of providing standardization across the DoD (Department of Defense, 2022). Most suppliers can easily obtain these and tailor their operations to comply with them. See Tables 1 and 2 for participants who had difficulties finding approved suppliers. These participants could not gather suppliers capable of producing some MIL-STD components at the production rates necessary to meet government-imposed requirements. Many commercial suppliers have well-established products or services that can meet most, but often not all, of the government requirements. For these suppliers to be considered, they need resources to make the necessary modifications so they can compete (Stockman & Wells, 2017). One situation experienced by Participant 1 and Participant 2

involved the printed circuit boards and fuses for defense missiles. Both participants could not identify the most capable suppliers, and a dedication to supplier performance risk management (to be discussed later) could result in a catastrophic incident (Rosenthal, 1989).

Among the components that separate missiles from bombs are the complexity of the circuit boards and fuses within them. Due to bombs either being dropped or launched using a separate device that imparts all its kinetic energy upon it, their circuitry tends to be much less complex. Missiles, however, include the additional components of their own propulsion system and guidance system that require advanced circuitry to communicate with each other to place the missile on target. As a result, the printed circuit boards and fuses have greater requirements within their prescribed standards. When suppliers fail to meet those standards, the Department of Defense (DoD) must decide whether to grant waivers to keep production on track or accept significant delays in receiving necessary inventories to maintain mission readiness. Such a decision had to be made in 1989 when Pentagon officials discovered that the circuit boards called stator switches, designed to arm the fuses within a missile, were defective in a significant number within the U.S. Defense arsenal. This forced the DoD to recall over 2,700 Phoenix and AMRAAM missiles to refit with older technology fuses and seek an alternate source from the previously deemed sole source, Asher Engineering (Rosenthal, 1989). This investigation began shortly after information came to light from the 1986 raid on Libya that at least 25 percent of the HARM and Harpoon missiles, which also contained the Asher stator switches, which were launched never detonated (Rosenthal, 1989).

The stator switches, awarded to Asher Engineering as a sole source based on its promoted capability to meet the difficult gold plating specification of a thickness no more than 0.0001 of an inch, were used by most of the rocket manufacturers for missiles such as the HARM,

Maverick, Harpoon, Sidewinder, Sparrow, Phoenix, Standard Missile (SM) and the newest missile, the AMRAAM (Rosenthal, 1989). According to Participant 1 and Participant 2, the Defense Criminal Investigative Service uncovered that Asher Engineering had been falsifying the required test records for most of its production. This resulted in four of the five Asher testing personnel being terminated and disbarred. Participant 2 stated, "We had an issue.....with the manufacturer of one specific type of board, and I say one specific type of board that it turns out.... the issue there was they (Asher Engineering) were falsifying their nondestructive test records."

According to a New York Times article, Navy officials had been warned for years that the switches might be suspect. However, rather than investigate the testing procedures and records, these officials continued to provide testing waivers to both Asher Engineering and Micronics International Corporation, the companies responsible for integrating the switches into its subsystem (Rosenthal, 1989). According to Participant 1, "Four of the five personnel responsible for the proper testing procedures were disbarred." The missiles were installed for an estimated 1 million dollars per missile; however, the estimated production cost of each stator switch component within each missile was 12 dollars. The follow-up action by the DoD was the task of finding a new source for the switches. It remains unclear whether a new source could meet the gold plating specification requirement or was the requirement modified to allow the older switch suppliers to provide the needed retrofit quantities with their previous switch products.

Lack of Interested Suppliers. The third condition that often leads to a sole sourcing relationship is a lack of interest among potential suppliers to submit bids or quotations for a given request. Most of the reasons a supplier may decide not to respond to a request-for-quote

(RFQ) from either the U.S. government or a prime-level contractor often include a competitive quotation or proposal against a strong incumbent of a previous government contract. Suppose government proposal requirements within an RFQ, such as tailored specifications or production rates, appear to be heavily favored towards a given source. In that case, potential competitors will not waste their time or resources generating what they perceive to be a "no-chance" proposal. Participant 8 noted, "We had multiple situations where potential competitors would not bid solicitations that they believed felt more like follow-on solicitations based on how tailored our specifications were."

Every interview participant had experienced situations where, while their solicitations for bids for certain programs were open and competitive, the solicitation's status as a follow-on contract was awarded to another supplier. The likelihood of the government awarding the follow-on contract to a different source was much lower than if there had been issues with the current or previous supplier. For a potential supplier to submit a bid, they must believe there is a genuine chance of being awarded the resultant contract.

Theme #2: Diminishing Supply Base and Resources. The next emergent theme challenging the Department of Defense (DoD) contracting officers and the defense industry was the significant reduction of both capable suppliers and available resources to continue producing resources to maintain operational readiness. The interview participants shared a common background of seeing the number of viable suppliers to send requests for proposals drop. During their tenures as suppliers, they witnessed contractors merge or be acquired by larger competitors or prime contractors seeking to expand their technical and manufacturing capabilities. Some also had experiences with diminishing resources, including materials critical for manufacturing key components and structures, and shortages created by shifts in either available global supply or

market demand from commercial products. These shifts caused a significant reduction of resources available for producing key defense products. Many formerly used products became more mainstream as the demand for better performing products in the commercial markets increased. Each of these is discussed in more detail in the subsequent subsections.

Mergers and Acquisitions. One of the key findings from the interviews was the effect of the significant number of mergers and acquisitions between key subsystem levels. These mergers also included component providers, prime contractors, teaming agreements, and government-directed partnerships that had occurred during their tenures as contracting officers. In the 1970s and 1980s, the aerospace and defense industry witnessed a boom in start-up small businesses by engineers who had participated in historical accomplishment programs. These initiatives included the Apollo and Gemini programs. Later, the Reagan administration's defense build-up heavily relied on patented components and took advantage of recently enacted government requirements for the larger defense firms to work with diversified small businesses to win prime contracts (Stockman & Wells, 2017). The DoD also pushed for contractors to partner on critical prime contracts where multiple synergies would be expected among the winning bidders. When the V-22 Osprey development contract was awarded to the Boeing-Bell Helicopter proposal team, it was promoted as a visionary alliance between a fixed-wing aircraft manufacturer and a helicopter manufacturer. This was to design and produce a new hybrid aircraft capable of hovering long-range, high-speed cruise performance (Stockman & Wells, 2017). Participant 2 revealed that the DoD mandated this partnership, and it generated a larger discussion about the possibilities of collaboration. Participant 2 stated, "Bell and Boeing were forced to work together on the development and exchange and all that sort of stuff, and then with the Peace Dividend."

Most of the mergers and acquisitions that took place in the 1980s focused on cost savings and synergies between firms that had grown too large to meet the small business requirements. These firms needed to realize other competitive advantages to win contract awards (Seo & Hill, 2005) in light of the fall of the Soviet Union and the "Peace Dividend" that followed. These awards encouraged western nations throughout the world to reduce their military spending. In 1993, during an interview later deemed "The Last Supper," then-Deputy Secretary of Defense William Perry encouraged larger defense contractors to consolidate to achieve efficiencies in an era of significantly reduced military expenditures. This continued during much of the Clinton administration (Harper, 2021). The atmosphere created within the aerospace and defense industry was an enormous consolidation of aerospace firms competing as prime contractors, dropping those submitting direct proposals for larger system contracts from 50 to 6 by the end of 2000 (Harper, 2021). The researcher was surprised that contracting officers who shared the trait of having tenures during the 1990s or early 2000s stated that they saw a significant difference between proposals in the early 1990s that included more competitive sourcing conducted by prime contractors at their subsystem, assembly, and component material levels. They expressed later proposals from post-merger and acquisition firms contained significantly more sole sourcing within their recent acquisitions. Participant 2 stated that "because of the desire for my agency to secure maximum technological development, I was sometimes required to set up the two best bidders of a contract as contractual teammates." Participant 7 added, "The political push for more mentor-protégé arrangements increased the content of sole-sourcing within many proposals we received." As the Bush 43 administration began increasing defense spending following the 9/11 attacks, the larger aerospace and defense firms began focusing on acquiring new capabilities, accessing emerging technologies, and expanding into new markets such as Asia

and the Middle East. Figure 2 below shows the substantial consolidation prior to 2007 within the defense industry of former competitors and suppliers that are now part of one of the four largest aerospace and defense firms in the country.

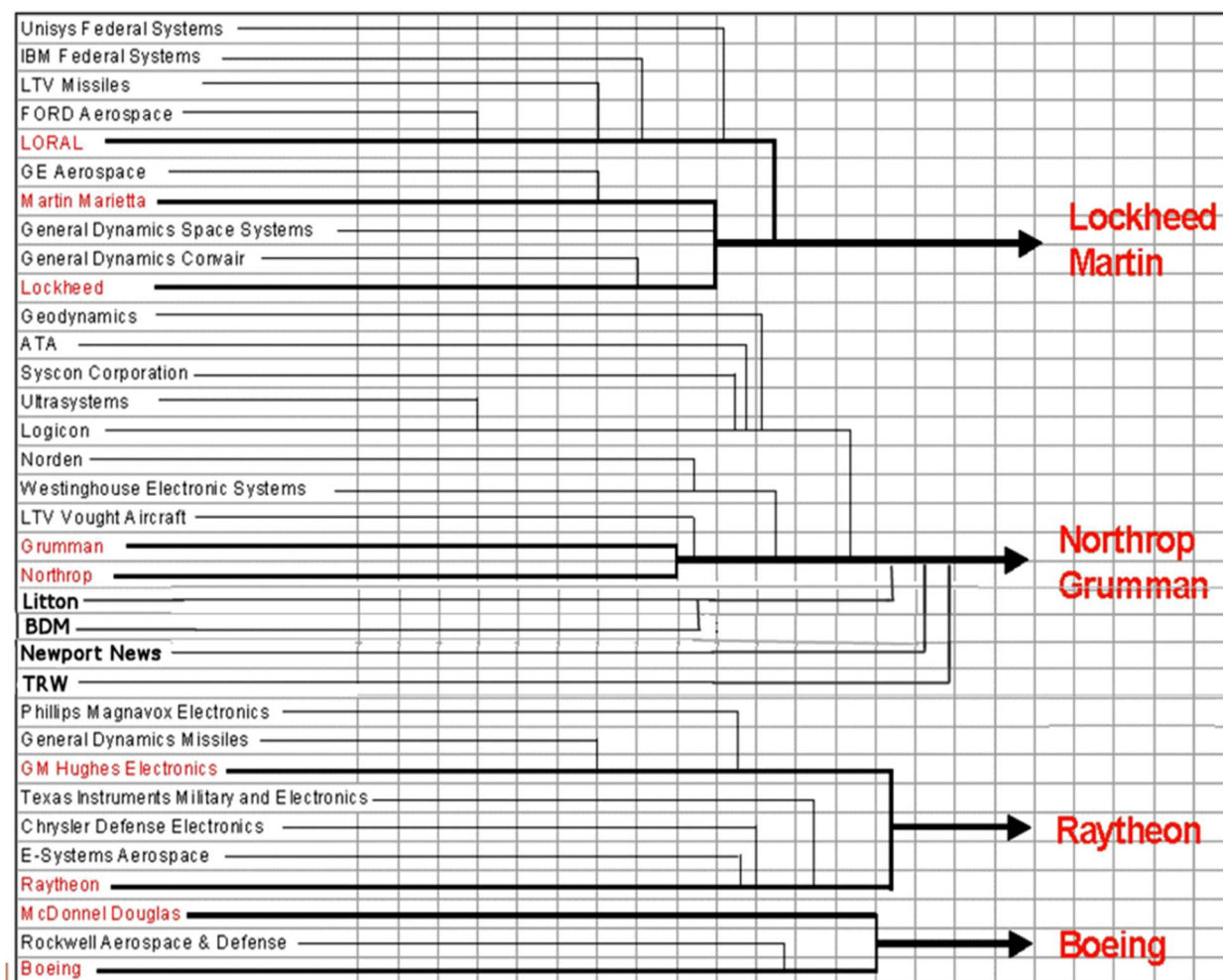


Figure 2. Consolidation prior to 2007.

Spending limitations from the Obama administration, including the Budget Control Act of 2011, had a major impact on the aerospace and defense industry. They affected all commodity areas, and vendor sizes as those receiving prime contracts from the DoD dropped by nearly 20 percent during its tenure. Participant contracting officers witnessed major reductions in contract negotiations, and the few defense initiatives sought had fewer yet larger prime contractors

competing for them. One interviewee stated how he believed the presence of the larger contractors bidding on smaller contracts presented an entry barrier to the smaller and medium businesses. Participant 5 noted, "We had a lot more lobbyists and business development representatives from the larger defense companies requesting information on bid opportunities that they would have considered too small just a few years back."

Limited Resources / Increasing Non-Defense Applications. One of the basic foundational principles of economic theory is the law of supply and demand. Many commercial products have either originated or been significantly improved due to applications of materials or processes within the government defense industry. Another takeaway from this research was to be more aware of the trends and anticipate the potential for commercial demand of materials that are solely or heavily relied upon for defense technology. One example experienced by Participant 1 and Participant 3 is the demand for titanium.

The U.S. defense industry and civil aircraft manufacturers have become more reliant on titanium-based products since the 1940s. The U.S. Defense Department declared titanium the "metal of choice" for defense applications, primarily due to its performance characteristics, including resistance to corrosion, high strength-to-weight ratio, and lasting performance under high temperatures. This made titanium a highly sought-after commodity as its properties were implemented into different applications across the aerospace and defense industry between the 1950s and 1980s, including both aircraft for its weight properties and ship hulls and submarines for its low corrosiveness. As its benefits became more well-known, the private sector industries began experimenting with its application in sporting goods and medical devices. Both Participant 1 and Participant 3 recalled a specific spike in titanium demand that significantly affected defense contracts in the 1990s – the sudden popularity of titanium golf clubs. Participant 1

recalled, "We were having difficulty in securing enough titanium for any of our programs, including the DX-rated task orders." DX-rated orders are those the Department of Defense (DoD) has given higher priority, and suppliers of raw materials and manufactured products are required to escalate them over non-critical DO-rated orders in their contracted workloads (Department of Defense, 2022). Participant 1 continued, "Despite those ratings, it was hard for (those of us) who needed titanium to build lightfast, whatever types, airplanes and so forth to get enough titanium compared to the high volume golf manufacturing people."

The primary driver keeping titanium from becoming a mainstream material was the cost of processing it and molding it into any commercial product that the average consumer could afford. Materials such as graphite and strong plastics were far easier to acquire and manufacture into the desired commercial item. However, one of the industries where the average consumer can afford to experiment with more expensive possibilities is the golfing industry. It's not improbable that a serious player could invest substantially in the pursuit of improving their overall game. The first titanium clubs were introduced in Japan in 1990 by Mizuno. Their clubs featured a titanium shaft and a titanium gold head and were expectedly very expensive – only the most affluent in Japan had them. However, their performance became increasingly seen at professional golf tournaments throughout the 1990s. Thus, the demand for titanium golf clubs and other derivatives also grew substantially during that period. Participant 3 commented, "At a certain point in time, golf club manufacturers started making titanium shaft golf clubs because they really are cool and they really do well for golfers."

Increasing applications for titanium included bicycle frames, tennis rackets, and even laptop computers for those being used in harsh conditions. The medical and dental industries discovered that it had an innate ability to join with human bone and continue to utilize titanium

for both artificial limbs and components for internal medical devices. Titanium was used for plates and pins for pacemakers. This surge in demand affected the availability of titanium around the world. While Japan was a producer of titanium for its products, the United States did not have the same domestic supply. To meet its demands, it needed to secure supply opportunities from other major producers of titanium. Participant 3 mentioned "This was one of the drivers of negotiations between both Russia and China – the only two countries at the time producing titanium in even bigger quantities than Japan". The price of titanium increased during the 1970s as its uses became more well-known (Wise, 1994). In the 1980s, President Reagan proposed it to the 600-ship Navy, and slightly during the early 1990s while it was popular in newer sporting goods items like gold clubs (Wise, 1994). However, the opening of markets in Russia and China in the early 1990s contributed to its significant decrease in price, though the United States was hesitant due to geopolitical concerns to negotiate significant arrangements with either nation (Wise, 1994).

Participant 3 recalled that the opportunities to secure titanium were improved in the early 2000s with the discoveries of mineral deposits in South Africa and Mozambique. Participant 3 stated, "While there was some in South Africa, ... the rest of it was in the Soviet Union." The significant improvement in both manufactured graphite and plastics technologies for some applications relieved the demand for titanium somewhat. Figure 2 showed the significant spike in prices during the second Bush 43 term, and the Republican congress generated a surge of demand for the next generation of aircraft and warships. The commercial marketplace generated renewed demand for rugged and lightweight products that benefitted from the properties of

titanium. Titanium continues to be a high-demand, limited supply resource that the DoD must continue monitoring as it considers its contracting priorities.

Theme #3: Supplier Performance Risk Management. The next emerging theme that was revealed was the perceived reduction in supplier performance risk management implemented across DoD programs by the current and former DoD contracting officers. Within this theme, three subthemes were developed. The interviews discussed the continued push for technical program managers, project management, vendor management, and key programs continuing to experience issues with suppliers who have had similar past performance issues. Participants acknowledged an improvement trend in the first of these two, which was discussed in the corresponding subsection below.

Supply Chain Management is a Secondary Priority to Technical Management. A common observance among the interview pool was the continued cycle of defense contractors favoring program management. These contractors shared common technical expertise and experiences with their senior management over hiring or elevating those with a more diversified knowledge and experience foundation. Participant 4 stated that he was aware of some shifts within the larger defense firms to experiment with hiring program managers with more experience. In general, project management, vendor management, and quality assurance acknowledge the difficulty that some firms must make to shift the priorities of today's government programs. Participant 4 expressed, "I had noticed more prime contractor program managers with more functionally-diverse backgrounds were being included in their key personnel proposal sections." More experienced contracting officers recalled when such skills were either learned on the job or small enough in scope to be lumped under either financial or operations. Participant 6 mentioned, "Prior to the mid-1990s, most program managers came from

the 'egg-heads,' the most technically smart engineers in the company. All the non-engineering functions were considered support staff. That's changing, I think, for the better."

The typical outsourced cost of programs prior to 2000 was estimated to be under 25%, with the bulk of the program price tag going to the prime contractor engineers. These individuals diligently work up designs, test and retest conceptual prototypes, and finalize specifications for its manufacturing and production engineers (Stockman & Wells, 2017). As programs become more reliant on outside supplier performance, just-in-time integration of components, assemblies, and subsystems is very important. The popular perception among the participants who identified this concern came from a more recent DoD contracting officer. He stated, "The drive was more toward compliance than a genuine adoption of the practice as an industry-standard within most defense contractor organizations I was evaluating. The proposal sections describing this seemed as if there was a common author among multiple prime contractors". What has been observable by the participants in this study was how a prime contractor's program manager has been able to address vendor management issues, including who within their team most contributed to issue resolution. This led to the second subtheme of this section, how many of these issues could have been prevented.

Not Enough Proactive Risk Mitigation Based on Past Performance. Most defense contractors, including all the major firms, maintain a robust supplier performance scorecard system within their organization for tracking and recording supplier performance during its active program activity. This is a periodic reporting requirement for most defense contracts over the \$2 million acquisition threshold. It is designed to create a usable resource for defense contractors to evaluate whether certain suppliers in their supply chain system should be utilized more or used less, if at all. In addition to cost and pricing information, these databases are

required to track scheduled delivery performance and quality metrics, including when subcontracted products must be returned to vendors for rework or scrapped as unrepairable. When prime contractors submit proposals involving significant subcontract activity, they are required to attest to the high confidence levels in the performance of their proposed subcontractors. They include any proactive risk mitigation plans for suppliers they may be required to use, whether directed by the government or otherwise necessary, to properly perform the prime contract within the required cost, schedule, and technical parameters.

The survey participants had common experiences with programs in which a second tier (or lower) supplier was driving a technical performance delay or a manufacturing capacity delay. This was not the first time many of the participants experienced this issue. Participant 6 described his experience supporting an Air Force program for the strongback framework for a prototype bomb rack system. The prime contractor had included multiple potential subcontractors for the strongback and the proposed pricing and delivery schedules for each proposed supplier. The prime contractor's original proposal had not been included in the prime contractor's source selection process for the strongback framework. Participant 6 reported, "The later report included the prime contractor program manager's decision to select the supplier with the best quoted price and delivery schedule, despite the selected supplier only having a 48% on-time performance score within the prime contractor's supplier performance database". According to Participant 6, the report showed that all other suppliers that submitted bids had quality scores above 85%, and two had scores above 92% - these were stated in the prime contractor's summary of award documentation. Not surprisingly, the selected supplier had significant issues meeting the delivery schedule of the prime contractor due to its inability to improve the selected supplier in a timely manner. They were not awarded the next phase of the prime contract. The lesson

from this incident was this is more likely to occur when there is a lack of sufficient risk mitigation. Recommendations from the participants included possibly awarding two suppliers competitive awards, working with the DoD contracting officer to agree on key selections mutually, and requesting the necessary equitable adjustment to keep the program on schedule.

Relationship of the Findings

This section identified and discussed the relationships between the data collection findings and the key elements of this study, including the research questions and the conceptual framework. It provided the follow-up alignment validation between the research questions, the interview questions from the survey, and the resultant themes that emerged from the data analysis. Following that, it demonstrated how the themes generated from the findings integrated into the conceptual framework and discussed which emerging themes were aligned with the anticipated themes. This revealed to the researcher the anticipated themes that were prevalent within the collected data and interviews.

Relationship of the Themes/Patterns to the Research Questions. The first interview question (IQ1) specifically asked the participants whether there were any subsystems or components initially identified as sole-sourced due to unavoidable conditions. The researcher utilized this introductory question to place the interview subject into a proper frame of mind for the questions to follow that delved deeper into their former programs. This question also inquired whether there were unavoidable conditions that had to be managed by the prime contractors as a prerequisite for contract award. The first research question (RQ1) tasked the researcher to investigate what strategies U.S. DoD contract officers use to reduce sole-sourced critical equipment components from the supply chain. The four sub-tiers research questions that followed all contribute to this comprehensive research question of looking into what has

historically been done to address the sole sourcing reliance issue. Together, they formed the foundation of how most of the interview questions were generated. Specifically, how the researcher developed the second interview question through the sixth interview question, which delved into the different phases of any useful strategies. Through these questions, the interviewed DoD contracting officers discussed preliminary strategies that they promote for reducing sole sourcing. These strategies include having multiple prime contractors negotiate licenses for any patented components, identifying multiple capable suppliers early in the solicitation process, and working to promote interest in a proposed project from multiple capable sources. These were all captured under the first emerging theme of avoiding sole-source reliance.

The second research question (RQ1a) was the first in the subset under the first question. The second emerging theme from the interview data collected specifically focused on this area and revealed that the most prominent contributor to the diminishing supply base was the significant proliferation of mergers and acquisitions within the defense industry. Periodic scarcity of materials such as titanium was also identified as a contributing factor to this theme. One of the significant revelations of this research study was the significant effect that the defense industry's rampant activity of mergers and acquisitions over the last 40 years has had on the sole-sourcing issue.

The third research question (RQ1b) required the researcher to inquire whether the U.S. DoD contracting officers have historically required prime contractors to address sole source reliance risks within the supply chain sections of their submitted proposals. The third interview question (IQ3) asked whether their program contracts required prime and sub-tier contractors to identify, address, and monitor sole source reliance risks within the supply chain sections of their submitted proposals. All of those interviewed responded that they had required supplier risk

identification and management in their requests for proposals during their full tenures as contracting officers. However, they also identified how their ability to research the supplier evaluations from prospective prime bidders was limited to what they could research of a supplier's direct work with the U.S. government and its work on previous government programs. In most cases, it was not, so the DoD contracting officers had to rely somewhat on or trust that the proposal submissions and resultant contract awards addressed and mitigated the most likely risks to the best extent possible. The next question (IQ4) inquired whether contractors were empowered or directed after contract award to negotiate with their sole source and single-source suppliers. This question focused on their operations and risk reduction activities to improve their likelihood of timely and quality product deliveries. This was the first portion of the emerging subtheme of insufficient proactive management of supplier risks. A consensus from the contracting officers was that a potential contributing factor was the lack of vendor management experience among some of their program management counterparts.

The next two research questions proved more difficult to address due to the limited exposure by most of the interview subjects to the overall operational readiness of the DoD. This research question (RQ1c) tried to address this topic, and the researcher attempted to go through the fifth interview question (IQ5), which tailored the inquiry to their previous programs or those they were intimately aware of. Their responses were somewhat limited, which the researcher understood as a former naval officer and fellow defense industry contracting professional as well. Still, this question and the following research question (RQ1d) highlighted the U.S. DoD's current strategy to address the increasing reliance on sole-sourced materials and components. The researcher inquired through interview question IQ6, leading this researcher to identify the subtheme regarding the need for more defense industry program management. This subtheme

highlighted the importance of better educated and experienced personnel in vendor management and project planning to better address the reduced operational readiness issues. These factors were identified in the last two DoD Inspector General's reports on the Top-10 DoD Management Challenges (Office of the Inspector General, 2019).

The final research question (RQ2) tasked the researcher with identifying the trade-off effects of significantly reducing sole sourcing within the U.S. DoD supply chain. This question directly inquired among the interview participants through the final interview question (IQ7). Beyond the identification of the challenges from avoiding sole-sourcing that were discussed earlier, such as the loss of the use of patented technologies and the possibilities of some suppliers not being interested in shared contract awards like the V-22 Osprey shared arrangement. The consensus of those interviewed was that there should be a continued interest within the defense industry to encourage capable suppliers to participate in the defense industry bidding process.

Relationship of the Themes / Patterns to the Conceptual framework. The conceptual framework for this study was built by combining key process steps within the U.S. DoD supplier sourcing process and the post-award contract performance process (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2020). After collecting data from the case study participants, the researcher perceived a relationship between the negative effects of sole source reliance and a DoD contracting officer's individual experiences, perceptions, and judgments as they proceed through the steps of each process. The purpose of this study was to explore some of the strategies that U.S. DoD contract officers use to reduce sole-sourced critical equipment components from the supply chain. The interviews were conducted in a manner that allowed the participants to provide significant insight to the researcher on some of the sole-sourcing reliance incidents that were also mentioned in current research and published findings

on this topic. The data gathered for this case study came from multiple perspectives. This included recently retired DoD contracting officers starting their civilian careers and others with long-time experience as corporate supply chain consultants or company executives. By utilizing the pre-interview survey, the researcher was able to identify those with the common experience of formerly managing at least one sole-source subcontractor in their role as a DoD contracting officer and experiencing programmatic issues due to having the sole-sourced subcontractor(s) among its program supply chain base.

The prominent concepts comprising the study's conceptual framework were the pre-solicitation activities, the source evaluation, decision process, source selection, and post-award performance (Department of Defense, 2016). The findings held strong relationships to these three concepts, which are phases of the overall DoD sourcing process. The emerging theme of implementing practices to possibly avoid sole-sourcing was strongly tied to the pre-solicitation activities, as they heavily influence the resource-based view (RGV) of the overall process. This was done by expanding the number of viable suppliers identified and was more likely to improve the likelihood of having more qualified suppliers for a given request-for-proposal. Similarly, the findings validated the concerns of the diminishing supply base and resources. This included the effect of mergers and acquisitions, which has a profound effect on the pre-solicitation activities. Fewer viable suppliers provide the necessary competitive environment to significantly improve the level of productive competence.

The other subtheme under the diminishing supply base and resources theme regarded both reduced resource availability and increased non-defense industry demand. This was more related to the post-award performance phase of a defense contract, as the concerns presented by this subtheme centered on the obtainability of resources. These contracts are often forecasted for

a date far beyond the initial contract award. This is because of the significant design review phases that characterize a standard defense contract for products not already pre-designed and in production. These two conditions within the subtheme are additional influencers on the red and green arrows within the conceptual framework depiction. They should be considered to be added to each of them. The improved availability of necessary resources, either through directly securing more sources or through a reduced demand from other applications, can reduce the risk of sole-source reliance. The inverse of these, hence, increases the risk.

Supplier Performance Risk Management and the need to further encourage its proactive implementation go directly to the source evaluation, decision element, and the post-award performance element of the conceptual framework. The practice of its processes and procedures can heavily improve both the pre-award and post-award activities. The DoD needs to recognize the shifting needed to have supplier program management that understands the logistical and operational aspects of their program contract activities as much as the technical engineering side of it. This can assist with evaluating prospective program manager resumes for these qualifications as a part of the proposal evaluation process. The positive effects of program management keeping a strong focus on supply chain management, specifically the supplier risk monitoring, would be evident throughout the post-award performance phase.

Relationship of the Themes / Patterns to Anticipated Themes. The literature review conducted before the research for this study led to several anticipated themes. As mentioned in Section One, early themes from the literature review included the evolution of understanding the source selection process and the closely related impacts of supply chain risks that affect business manufacturing and its customers in the value stream. From that evolution, anticipated themes included:

1. Understanding how production competence determines both the competitiveness and performance of suppliers.
2. Consideration of source selection criteria beyond competitive pricing that likely contribute toward the total cost of awarding a contract to a given supplier.
3. The additional conditions the DoD contracting officer community and businesses soliciting for contracts under the United States federal government must address and comply.

The findings strongly supported all three anticipated themes, including the latter two. The first anticipated theme of determining the competitiveness and performance of suppliers should be supported through the findings. The lack of identifying both capable and interested suppliers will likely drive the competitiveness of a sourcing opportunity lower and, therefore, drive the incentive to perform highly following contract award lower. The findings upheld the proactive implementation of Supplier Performance Risk Management through pre-award evaluation and investigation of potential suppliers during the source evaluation process. This includes making suppliers aware that such thorough evaluations should be expected. A business' age contributed to uncertainty for cash infusions.

Consideration of source selection criteria beyond competitive pricing is precisely what effective Supplier Performance Risk Management entails. The DoD source selection process must focus on the best value concept over the simple calculation of the most competitive price. A strongly related concept discussed in the literature review is that of the total cost of ownership. Most of those who spend a significant amount of time researching how to purchase an automobile for themselves understand this concept. It is no different in the application to evaluating potential sources of supply. The principle that "Schedule is King" is often repeated for

most government prime contracts. This is due to the high dependency placed on programs, completing on time, and meeting all the performance criteria.

The remaining anticipated theme was identifying additional conditions the DoD contracting officer community and businesses soliciting for contracts under the United States federal government. Among these were the subthemes of confronting patents and other intellectual property issues while keeping up with the markets within all commodities affecting the industry. This would assist with identifying potential capable suppliers and encourage their interest in potential contract opportunities. Additional conditions also include understanding how key suppliers who performed well previously may have merged or been acquired, not necessarily guaranteeing the same level of performance for their next contract. Lastly, ensure prospective prime contractors assign program managers with the requisite experiences based on the planned program activity.

Two unanticipated themes were identified among the findings of this study. The first was the profound effect that mergers and acquisitions within the defense industry have had on increasing sole-source reliance throughout the DoD contracting community. While it makes sense that the number of suppliers, in general, would be lower, the effects of mergers and acquisitions are not limited to the simple mathematical calculation of a reduced number of suppliers. There is an additional effect based on the availability of the former supplier, now likely a subsidiary of a larger defense firm. This is being significantly reduced as some large firms may not want to provide the same products or services to a competitor who was a former customer of the acquired supplier. Another is the effect of the commercial marketplace demand for similar materials that the DoD relied on for the timely production of its necessary products. Much of the demand is a result of awareness by a few in the defense industry of the military

applications of key products or raw materials and envisioning additional non-defense uses for the same or similarly designed products.

Relationship of the Themes / Patterns to the Literature. Several themes from the current academic literature were persuasively relevant to this case study. These themes formed the initial pillars upon which the case study research data was collected and analyzed. The findings of this study primarily concentrated on the latter of these three, but all of them shared commonalities. These pillars were: a) applicable supply chain management practices; b) government and DoD supply chain management; and c) sole-sourcing reliance issues. To properly conduct this research on increasing sole-source reliance within the DoD contracting, it was essential to complete an exhaustive literature review that included the foundational pillars of applicable supply chain management practices and how they are applied within the U.S. government and the DoD. Most of the focus of the literature review was appropriately dedicated to sole-sourcing practices and related to supply chain topics throughout the general business community. This also included significant discussion about the inherent risks of sole-sourcing reliance within the U.S. DoD contracting profession, which is the purpose of conducting this case study (U.S. Department of Defense, 2019).

Relationship of the Themes / Patterns to the Problem. The findings proved that the problem of increasing reliance on sole-sourced critical defense components within the U.S. DoD supply chain network resulted in increased risks of operational units not achieving the agency's minimum requirements of operational readiness. This can be addressed with proactive awareness of some conditions that increase the probability of a sole-sourcing arrangement. Participants identified the opportunities for greater attention for both DoD contracting officers and the larger prime contractors to proactively avoid sole-sourcing when possible and seek and identify capable

and interested suppliers early. Experienced participants explained both the internal and external contributors to the sole source reliance issue, which they believed can be either prevented or reduced in likelihood from occurring. The participants highlighted proactive Supplier Performance Risk Management and experienced vendor management.

Summary of the Findings

The researcher has provided a comprehensive overview of how the collected data from conducted interviews were analyzed and aligned to the problem being studied and research questions from Section One. The researcher was able to obtain responses from 36 potential participants who were current or former Department of Defense (DoD) contracting officers, eight of whom were interviewed after confirming that they had experienced sole-sourcing reliance issues during their tenures as contracting officers. The interviews were conducted using the Interview Guide found in Appendix A. There were seven questions asked to the participants during the individual interview sessions, and the respondents were able to provide detailed knowledge about their experiences, including actions they took and what they perceived as significant contributors to the increasing sole source reliance issue.

The themes that emerged from the data collection were consistent with recent and past literature reviewed and aligned with the conceptual framework proposed in Section One. The emergent themes addressed most of the research questions thoroughly and supported the alignment between the research questions and interview questions. The researcher established three emerging themes and three subthemes within each: avoidable sole-sourcing, diminishing supply base and resources, and supplier performance risk management. Under avoidable sole sourcing, the subthemes included patented products, lack of capable suppliers, and lack of interested suppliers. Two unanticipated themes were identified under the subtheme diminishing

supply base and resources. They were mergers and acquisitions and increasing non-defense applications of key resources relied upon by the DoD. Under supplier performance risk management, the themes were the need for supply chain Management to share a higher priority with technical management and not enough proactive risk mitigation based on past performance. The researcher did not find any discrepancies in the literature or within the findings of this study.

Using the identified themes, the researcher addressed the research problem of addressing the increasing reliance on sole-sourced critical defense components within the U.S. DoD supply chain network. This reliance has resulted in increased risks of operational units not achieving the agency's minimum operational readiness requirements. The purpose of the research was to explore the strategies that some U.S. DoD contract officers use to reduce sole-sourced critical equipment components from the supply chain.

Applications to Professional Practice

The next section described some potential opportunities for applications of this qualitative multiple case research study to the professional practice of defense contracting. This research became meaningful and applicable to professional practice for several reasons, which are detailed in the subsections below. These results provided common perceptions within the DoD contracting community that can be leveraged to improve the practice of defense contracting. The researcher believed that the findings within this study are beneficial to both the current contracting officer community within the DoD and those seeking continued or increased contracting with the agency in the fiscal years to follow. Potential strategic applications will be introduced to the DoD agency and those defense firms seeking to market themselves as contributors to addressing this top DoD management challenge (Office of the Inspector General, 2019).

Improving General Business Practice

The general business practices have not reflected a strong degree of accomplishment in this area, as both the identification of the sole source reliance issue by the DoD Inspector General and the findings of this study conveyed (Office of the Inspector General, 2019). The DoD's source selection process aims to deliver "quality and timely products and services to the Warfighter and the nation at the best value to the taxpayer" (Department of Defense, 2016, p. 1). This section discussed how the findings of this study could improve the general business practices within the defense contracting industry. This has special importance due to its role in providing the necessary equipment and services to protect our active-duty service members and the uncompromising defense of the country.

The conceptual framework of this study recognized that one of the DoD contracting industry's goals must be improving the production competence of those products and services provided to the United States Warfighter. Improving production competence for prime contractors and major suppliers within the defense industry often leads to more business opportunities within the DoD supply chain network (Blum, 2019). All three of the main emerging themes have direct applicability to the DoD source selection process. Their implementation can assist DoD contracting officers by improving the likelihood that more of their contracts will be awarded competitively among multiple qualified sources. Furthermore, enhance the likelihood that those awarded as sole-source contracts are based on unavoidable circumstances (Howard et al., 2016). According to each of this study's eight participants, agency-imposed conditions such as time constraints, politically directed preferences, and technologically driven objectives prevented them from fully exploring the full range of potential suppliers that were both capable and interested in participating in each bidding process. A review of the

literature revealed that some contracting officers were experiencing this situation, but not to the extent communicated by the study participants (Blum, 2019; de Rassenfosse et al., 2019; Howard et al., 2016).

In 1736, Benjamin Franklin was credited with saying, "An ounce of prevention is worth a pound of cure" (Kiel, 2011). Two of the emerging themes from this study, avoidable sole sourcing reliance and supplier performance risk management, strongly backed that premise. Both themes fell under a common business practice within supply chain management known as performing due diligence. Due diligence includes the market research necessary to formulate a thorough competition strategy so that the best informed decisions can be made (Stockman & Wells, 2017). It is one of the actions shown in the conceptual framework under the pre-solicitation activities flow, and its success can be significantly improved through the application of the findings from this study. These actions include researching patented items within a program where certain licenses need to be negotiated. Investigating applicable commodity markets to identify suppliers capable of providing important products and services improves the opportunities for such suppliers to participate in the DoD source selection process (Blum, 2019). The next section highlights deeper into how improvements can be realized through the tactical applications of the study's findings.

One of the prime movers encouraging contractors to find counterparts to merge with or acquire was the "Last Supper" speech given at a 1993 Pentagon dinner by then-Secretary of Defense Les Aspin. His deputy, William J. Perry, advised defense industry participants to heavily consider consolidations based on their forecasting of limited opportunities. This was based on the new president's initiative to scale down defense assets and the excess capacity that the industry currently faced. Though they stated in their speech that they would allow the market

to play its role in streamlining the industry, their comments set off a whirlwind of negotiated consolidations between key defense companies. According to this study's findings, it was far more difficult for DoD contracting officers to maintain a competitive environment for contract negotiations. In recent years, the DoD has improved how it examines proposed mergers and acquisitions, realizing to some degree that to ensure there are ample opportunities for small businesses to compete for smaller defense contracts. Some contracts must be set aside that require small business certifications and limitations on which larger firms can merge and still be considered fair competitors. The findings of this study suggest that the DoD should continue to promote small business opportunities and limit which aerospace firms can consolidate to improve the competitive environment. This can reduce the reliance on sole-source suppliers.

Regarding program management capabilities, it remains vital for program managers to understand the technical aspects of their projects. The findings reveal the additional need for program managers with a diversified knowledge base and multi-functional experiences, including vendor management and supplier quality assurance. Some of the major defense firms have created multi-functional job requisitions for many of their next-generation program managers. The results of this study demonstrated that those in pursuit of the larger, more complex defense program awards could have a competitive advantage by having a pool of personnel capable of addressing technical and logistical challenges within their program's supply chain management.

Potential Application Strategies

Every one of the study participants had significant experience in the DoD contracting experience, and most had turned their earlier careers as DoD contracting officers into successful private industry contracting professionals. Some of them have published their own reference

materials based on their experiences and strong desire to see improvement in the defense contracting profession. Others were very helpful to the researcher by referring him to additional reference materials that they either used daily or helped corroborate their experiences as a historical reference source.

Regarding patented products, DoD contracting officers need to be given the necessary resources to research the entire industry. This can assist with determining if such products truly provide unique performance, are available on the commercial market, or through a competitor willing to provide the DoD a more desirable license. While the research and development that leads to inventions should not be discouraged, the importance of securing the utilization of such products while being good stewards of available government funds should not be ignored.

DoD contracting officers should also be given the necessary resources to investigate and qualify multiple capable suppliers for the most desired products and services. As identified in the study's results, the lack of these leads to more than simply giving leverage to one preferred supplier. The bigger concern was unpredictable surges in demand and the lack of production capacity that comes with not qualifying more than one source to produce a given item or service. Both the DoD and the major defense contractors should be highly encouraged to develop multiple sources that can produce a given item or service much sooner than the anticipated demand for them is forecasted.

To address the challenges of competing with non-defense industry manufacturers for similar resources that are in short supply, the DoD needs to work with the major defense firms to strategize how to invest early. Acquiring these resources can encourage the development of alternative methods, materials, and services that can replace those in high demand by competing for commercial markets. The DoD program life cycles are longer than most commercial

technological life cycles. The issue of not being able to secure key materials that enable high technology production is unavoidable, but it can be proactively managed. It can reduce cost and schedule impacts on DoD programs (DMSMS guidebook, 2006). The DoD has been administering the DMSMS program for over 15 years, so it has no reason to be reactive on this issue. This program needs to grow from one of "best-efforts" compliance to a "mandated" requirement if the DoD is going to realize the proper respect and attention from its prime contractors on this problem.

With every new presidential administration that focuses on reductions in defense spending as a campaign commitment, mergers of mid-size contractors and larger contractors seeking acquisitions to obtain access to new technologies become more prevalent. National Defense reported that they and many leading consulting firms are predicting another wave of mergers and acquisitions to continue to become more specialized as they become larger in scale since their low point in 2015 (Harper, 2021). There is an additional forecasted demand for highly technological advancements in new areas such as over-the-horizon (OTH) communications, expanded surveillance and reconnaissance, and uncrewed and autonomous vehicles (Harper, 2021). The findings of this study directly contradict the assertion made by major prime contractors that these mergers and acquisitions have not weakened competition or impeded innovation (Harper, 2021). The DoD Industrial Policy's Mergers and Acquisitions Program, under DoD Directive 5000.62, was specifically established in 1996 to review all proposed defense industry mergers and acquisitions. Among its four criteria to review "ensuring a full and fair consideration of competition and innovation relating to defense programs" (Department of Defense, 2017, p. 1). It is this specific criterion that the findings of this study hopefully shed light on the agency's need to be performed better since this directive's inception in 1996.

Major defense firms have already begun demanding more from their next generation of program managers, including working knowledge of the Defense Acquisition System (DAS) and the DoDI 5000.1 and 5000.2. These programs cover the agency's acquisition process. As a result, internal training programs within firms such as Northrop Grumman Corporation and Raytheon Technologies and external training courses from organizations such as the Defense Acquisition University (DAU) include substantial instruction in program supply chain management and supplier risk management (Defense Acquisition University, 2022). As the findings of this study reflect, training programs are a strong indication that the defense industry already acknowledges this study's findings regarding its need for more proactive supplier risk management and supply chain management expertise among its program management community.

Summary

The applications of the findings from this qualitative multiple case research study will improve the general business practices within both the Department of Defense (DoD) and those defense firms seeking to continue or increase contracting with the agency. The DoD has acknowledged the need to make some improvements, as evidenced by its implementation of the DMSMS program. Furthermore, with the establishment of the Industrial Policy and the February 2022 DoD report titled "State of Competition within the Defense Industrial Base" (Department of Defense, 2020). However, this researcher hopes that the additional applications of these findings are heavily considered and carried out to the maximum extent possible.

Recommendations for Further Study

After reviewing the available academic literature and identifying the emerging findings, the researcher identified some areas of opportunity for further study within the field of government contracting. Specifically, within the Department of Defense (DoD), that could be

beneficial to the academic field of study, the American taxpayer, and the military warfighter. During the field study interview process, it became evident that the perspective of the DoD contracting officer community has not been fully explored by most of the academic scholars writing about the defense industry or government contracting practices. It was also apparent that there are barriers preventing many from objectively commenting on key issues that may be worth further exploration. The recommendations in this section stem from what was learned through the academic literature review and revealed as potential topics for further investigation by participants.

A strong recommendation for further study is exploring the effects of the high number of mergers and acquisitions on the aerospace and defense industry. These mergers have consolidated most of the major defense contractors and a large portion of the small to medium-sized businesses. This recommendation for further study may not be welcomed by those defense contractors still seeking to execute mergers or acquisitions. However, the purpose of such a study should be to help objectively identify those that would benefit the defense agency and the American taxpayer.

Another topic not readily identified from the review of available professional literature was the demand for essential materials used for defense applications by commercial industries and how the DoD could address how to secure what it needs to maintain the necessary level of operational readiness. Related to this topic were the efficacy of the DoD's DMSMS program since its inception and what could be done to improve its effectiveness in addressing the DoD sole source reliance issue. Future studies would also benefit from the agency's goal of improving its ability to provide necessary operational hardware and services to the warfighter.

Reflections

Working through this research project presented many challenges, academically, professionally, and logistically. The academic challenges were those commonly shared among doctoral students regardless of the research topic. These challenges included working through each portion, addressing regular feedback, waiting on processes such as the IRB, and conducting the research. Talking to other doctoral students and recent graduates through social media helped significantly understand that these challenges were not unique. This community was a part of the overall dissertation process. Professional challenges included setting aside personal bias and preconceived ideas about the research topic, given my professional background in the defense contracting industry. To lessen these concerns, I utilized a structured interview process and ensured the interview participants' responses determined the findings' strengths. I learned that there are root causes and concerns that did not align with my perceptions, forcing me to broaden my understanding and recognize newer viewpoints that I had uncovered. As one of my longtime mentors taught me, "There are things I do not know, but there are also things that I do not know that I do not know!" This research project strongly reminded me of that, and my knowledge in this field of study improved.

The logistical challenges to conducting this research had to do with underestimating the challenges of finding interview participants who qualified for the study. Moreover, finding individuals who were willing and able to participate during the time of year that this study was being conducted. The researcher's outreach to two major professional associations tied to the defense industry, the National Contract Management Association (NCMA) and the American Institute of Aeronautics and Astronautics (AIAA), yielded far fewer responses of interest than anticipated. The researcher affirmed it was not due to any limitations from either organization;

both were extremely cooperative and supportive of this research topic. The researcher suspects the calendar timing of the solicitation requests, between early September and late November, affected the responses due to the September 30th end of the fiscal year. That time period is when DoD contracting officers are extremely busy completing tasks for current contracts before the fiscal year ends. They are also reviewing solicitations and preparing to issue new contracts as soon after the new fiscal year begins on October 1st. Due to these annual recurring activities, the message boards are visited much less during this time of year. Most volunteer participants requested interviews after October 30th, when they would have more free time to participate. I had to stay flexible and wait for the participants that had expressed interest to become available, appreciating their willingness to support my research.

Personal & Professional Growth

It will have been a full five-year journey since diving into this doctoral challenge, returning to school for the first time since 2004 when I completed my master's degree in business administration through Regis University. I will be attending my 30-year class reunion with my brothers and sisters from the "greatest Naval Academy Class of 1992", having earned a general engineering bachelor's degree in science along with my Naval Officer Commission. My experiences in the defense industry go back even before my current 20-year aerospace supply chain career and even farther back than my 11 years of naval service for our great nation. I've been blessed to have observed my parents, both experienced in this industry as well. My father's experience is well-documented and easier to verify – Apollo 11, Voyager, the Space Shuttles, and dozens of satellites and other programs that cannot be discussed "in the open" all include his fingerprints. The homeland security and strategic business development fields within this industry bear lessons from his accomplishments. I believe his aerospace engineering experience,

knowledge, and understanding are in the top one percent and possibly unmatched by any other aerospace professional. I also believe, however, that his biggest contribution was not his direct knowledge or advice; it's how he networked with others in the industry and saw the potential of others early in their careers, often before they did. He could quickly determine which people needed to collaborate to solve the most difficult challenges and ensured they got together to do so. Personally, I posit that it takes an understanding of the defense industry that very few possess. I'm proud of his successes, but I'm even more proud of the legacy that so many others he mentored along the way are part of and still talk about way beyond his 2009 retirement.

My mother's contribution to the defense industry is one that I believe has rarely been told or recognized. She earned her degree in quantum mathematics while raising my sisters and me and was quickly hired to work on key defense programs. Shortly after taking a new position as a business manager at one of the leading aerospace firms in the early 1980s, she was invited to attend what was to become the first Asian-Pacific support club in the private sector of the defense industry. As a Filipina, she became one of the leaders of that club and, rather than allow the club to be a regular complaint session, advocated strongly for the members to overcome their issues. These issues ranged from language barriers to having guest lecturers teach presentation skills and how to network outside of their cultural comfort zones. My mother saw some of the smartest men and women in her firm watch others brief executives on their findings and accomplishments because of these barriers. She knew that they needed to be the ones making those presentations and receiving the credit. For this, she also ran into some workplace obstacles and was "conveniently" part of first-round layoffs from the firm. She knew what had really happened but refused to let that define her. She became a successful real estate agent and even more successful real estate investor. More importantly, she became one of my closest mentors,

role models, and one of my closest friends. There's only one person I trust more than her, and I ensured I married that person!

Regarding this specific doctoral journey, my pursuit of this degree and selection of this topic was based on my desire to do two things. First, I wanted to be recognized as a legitimate and certified subject matter expert in this field based on all of the guidance, wisdom, and knowledge passed down to me. Second, and more importantly, this curriculum has allowed me to see just how large and expansive the supply chain management and global logistics field of study truly is. Each course I took prior to this research project included classmates from other industries, and it has been fantastic to learn the similarities and differences in how our business practices are applied. Even with this research topic falling within the defense industry, I have learned much from interview participants and scholars who have written or spoken about this topic. My growth in understanding this topic and the aerospace industry, in general, has been substantial. I hope that this degree will grant me more opportunities to advocate for strategic solutions and become one who is sought after when the most difficult situations in supply chain management, in the defense industry, or beyond. I realize, though, that my biggest asset will not be simply what I know but the combined knowledge of my network and my inherited enthusiastic persistence to find the correct answer, no matter the political or cultural challenge.

Biblical Perspective

Throughout this research project, I have had the opportunity to continuously reflect on the substantial, liberating impact that the work performed by Department of Defense (DoD) contracting officers and many of those in the government contracting profession. Whether the work was professionally or academically, it contributes toward fulfilling God's vision. Whether as government representatives or private industry contributors, it is important to be better

equipped to recognize the vocations of duty that everyone contributes to the biblical worldview God has revealed. In their book *Every Good Endeavor*, Keller and Alsdorf (2012) dedicated the first four chapters to describing God's perspective on work and business. Central to me is the premise that God has provided all of us with unique skills, talents, and, more importantly, internal motivational drives to perform our work. These callings help us become closer to Him through the joy we feel in addressing challenges. Like this research project, these challenges push me to continuously grow and learn in this field of study. "Whatever you do, work heartily, as for the Lord and not for men" (*English Standard Version Bible*, 2001/2022, Colossians 3:23). Solving issues that improve the profits of a business promotes the continual and new employment of others, promotes fair trade, equitable pay, the welfare of employees and community, and fulfilling God's will.

The topic of the DoD's sole-source reliance could easily be rephrased as sole-source dependence, meaning that the DoD has increased its dependence on another entity. The purpose of this study was to seek opportunities to reduce this dependence. An interesting passage on promoting one's self-reliance comes from 1 Thessalonians 4: 11-12, "Aspire to live quietly, and to mind your own affairs, and to work with your hands, as we instructed you, so that you may walk properly before outsiders and be dependent on no one" (*English Standard Version Bible*, 2001/2022). This passage advises that we must be careful how dependent we become on someone. While I do not think it discourages interactions and business relationships with others, it states that one must not be dependent on others to have them addressed. "A false balance is an abomination to the Lord, but a just weight is his delight" (*English Standard Version Bible*, 2001/2022, Proverbs 11:1).

The dedicated focus that the DoD contracting officer community has for their work, and for which this study has been dedicated, further highlights the uniqueness of each defense industry professional. Their work is directly linked to the industry, whether still performing with the agency or in a private sector role. "Only let each person lead the life that the Lord has assigned to him, and to which God has called him" (*English Standard Version Bible*, 2001/2022, 1 Corinthians 7:17). In this scripture, Saint Paul revealed God's perspective that each individual's occupational ambition is not by chance; God has driven them through their unique skill sets and inner motivation to respond to His calling. Business leaders seeking to articulate an effective business strategy that addresses a biblical worldview can realize how identifying talents and capabilities can inspire employees to utilize those talents and motivators to their maximum potential.

Integrating business functions with a Christian worldview means remembering who has empowered us to be proficient in such areas and holding ourselves to the high standard of ethical and moral behavior expected of us. "You shall remember the Lord your God, for it is he who gives you power to get wealth, that he may confirm his covenant that he swore to your fathers, as it is this day" (*English Standard Version Bible*, 2001/2022, Deuteronomy 8:18). Understanding that it is for His will that we must be focused will ensure that we perform our roles and engage in business practices in the manner that brings Him greater glory. We must believe in a "transforming culture" that is enabled when an organization's employees become more than labor commodities or resources. They transform into mutually valued partners committed to the organization's success, both financially and reputationally. Keller and Alsdorf (2012) discussed this phenomenon in which our approach to work becomes a vocation to serve God and others. "A job is a vocation only if someone else calls you to do it for them rather than for yourself. And so,

our work can be a calling only if it is reimagined as a mission of service to something beyond merely our own interests" (Keller & Alsdorf, 2012, p. 55). This researcher hopes that many of those participating in DoD contracting would feel empowered and more likely to perform diligently and ethically through a shared commitment to their organization and the Lord, rather than working for their own self-worth. "In the same way, let your light shine before others, so that[a] they may see your good works and give glory to your Father who is in heaven" (*English Standard Version Bible*, 2001/2022, Matthew 5:16). An effective business strategy must, in addition to its guiding vision for professional performance, reinforce the importance of Christian principles and values in every activity it is engaged. It must establish a firm understanding that part of performing to the best of one's abilities is to do so responsibly, ethically, and in moral service to the Lord. This can inspire a welcoming responsibility on how an organization's members perform its business activities and how it holds itself and others within its influence accountable.

Summary

The researcher experienced many challenges in completing this research project from an academic, professional, and logistical perspective. The appreciation for the DoD contracting officer community has increased dramatically and for those who have successfully gone through the dissertation process before him. This research project required overcoming situations brought on by the process itself and performing specific tasks during certain times of the government fiscal year. Personal growth came through realizing how much of the defense industry and the supply chain management field of study is still new to the researcher. This translates to many opportunities to expand his knowledge and network of others regarding specific subject matter expertise in a targeted area is needed. The researcher shared the foundations of his enthusiasm

for the defense industry, building strong networks, and persistence to make improvements regardless of political pressure from his parents. His understanding has deepened regarding how the Christian worldview connects to the business functions explored while completing this study.

Summary of Section 3

Section Three emphasized applying professional practice, recommendations for improvement and further study, reflections from personal growth, professional growth, and the biblical perspective. After a detailed overview of the study, the researcher presented the findings from the conducted research on sole-source reliance within the DoD that focused on the research questions from Section One. This section discussed emerging themes from the collected data, including its representation and visualization, and how its interpretation led to the presented findings. Section Three connected the findings to a considerable body of literature from academia, industry media, and DoD policies and procedures.

The applications to professional practice included potential opportunities for improving the general business practices within the DoD and major defense firms. Also, the applications demonstrated how the defense agency could take independent measures to address some of the findings from this research. Recommendations for further study included exploring how many mergers and acquisitions have affected the defense industry and how the DoD should address its competing demands for essential resources with the commercial marketplace. This can maintain its necessary level of operational readiness. This section then provided reflections on the researcher's life experience, including how conducting this research has been important to his personal and professional growth. Lastly, the researcher highlighted why conducting this research has been an important endeavor toward connecting the business community with the Christian worldview.

Summary and Study Conclusions

The general problem to be addressed was the increasing reliance on sole-sourcing within government agencies' and business organizations' supply chain networks, resulting in heightened risks of operational readiness reduction and manufacturing production delays. This research study focused on sole-sourced critical defense components within the U.S. DoD's supply chain network and the increasing risks of operational units not achieving the agency's minimum requirements of operational readiness. This was due to the lack of on-time availability of those components (U.S. Department of Defense, 2019). The additional problems and effects created due to reliance on sole-sourced commodities resulted in this issue being listed in the DoD Inspector General's report of "Top DoD management challenges - Fiscal year 2020" (U.S. Department of Defense, 2019). This qualitative case study contributes to the foundational knowledge of supply chain management practices. It brings attention to some of the root causes of this business concern that troubles both government and commercial supply chain networks.

The data collection for this research included interviews with former and current DoD contracting officers who shared their direct experiences with this issue and some of the factors they believed contributed to its growth. The literature review conducted prior to the research process raised some anticipated themes such as production competence, non-pricing source selection criteria, and additional conditions that DoD contracting officers face beyond those of the commercial marketplace. The interview responses were evaluated, and several themes were identified among the findings. The researcher recommends further investigation within the defense industry. One such theme, mergers and acquisitions within the industry, began with a few in the early 1980s, became more common in the late 1990s, and even more so recently not only affected the number of competitors for defense commodities but some of the strategic

incentives to compete aggressively. The DoD played a major role in the proliferation of industry mergers and in encouraging prime contractors to negotiate teaming agreements to reduce the competitive environment. Another theme that emerged as a significant contributor to the research topic was the increasing non-defense industry applications of defense industry resources, such as titanium and certain specialty plastics. Demand for those materials rose significantly as information about the performance of defense equipment and capabilities became easier to research and test in the general marketplace.

Identifying these themes and applying them to the findings yielded two recommended areas for further study and research, both within academia and the defense agency. First, the researcher recommended further study on the effects of the industry mergers and acquisitions among the major defense contractors and small to medium-sized businesses. The next should be an in-depth evaluation of those critical defense industry materials increasingly used in non-defense applications and how the DoD could address how to secure what inventory needs to maintain its necessary operational readiness. Both potential studies would assist the agency in addressing this top management challenge identified in the last two Inspector General reports. Furthermore, this can assist the agency's goal of improving its ability to provide necessary operational hardware and services to the warfighter (Department of Defense, 2019, 2021).

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Appendix A: Proposed Interview Guide

IQ1. When your program / project was originally proposed, were there any major sub-systems or components within the overall platform or system already identified as sole-sourced due to unavoidable factors such as technology patents or government-directed outsourcing?

IQ2. Was there any internal analysis conducted to identify sub-systems, components or raw materials that had an increased risk of becoming sole-sourced due to a diminishing supply base or pending governmental or industry activities?

IQ3. To what extent did your program require its prime contractors and sub-tier contractors to identify, address and monitor sole source reliance risks within the supply chain sections of their submitted proposals to your team?

IQ4. Were these contractors empowered, or possibly directed, after contract award to negotiate with its sole source and single source suppliers regarding their operations and risk reduction activities to improve their likelihood of timely and quality product deliveries?

IQ5. How did the level of reliance on sole sourced hardware and components within your assigned programs and projects affect its internal program management and the subsequent program performance, including initial contract milestone completion dates, sub-system and component quality, and the organization's forecasted level of operational readiness to utilize the contracted platform or system?

IQ6. How well do you believe the current or former DoD strategy (at the time of your program experience) effectively addressed the likely reliance on sole sourced materials and components during the production and operational lifespan of your program's final product?

IQ7. What do you believe would have been some of the trade-offs that had to be made to reducing sole sourcing within your program, and would you have made them given those possibilities?